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ANTHROPOLOGICAL STUDIES IN INDIA

ALTHOUGH India offers in its aboriginal tribes and its diversity of peoples, languages, and cultures a field exceptionally favourable for the development of anthropological studies, it cannot be said that either Government authorities or those responsible for the direction of higher education have given them the encouragement which such opportunities deserve. The valuable work initiated by Sir Herbert Risley, and more particularly the Ethnographic Census, has been allowed to lapse, while until recently the universities have shown little inclination to include this important department of investigation within the range of subjects in which they have provided facilities for research. It was, therefore, doubly unfortunate that for some considerable time interest in Indian racial and cultural history was fostered by argument of a strongly tendentious character. The 'dry light' of pure science and disinterested research was, however, kept aflame by a small band of devoted enthusiasts, among whom the veteran anthropologist, Sarat Chandra Roy, will ever be held in honour. The establishment of a department of anthropology in the University of Calcutta, under the guidance of the late Sir Asutosh Mookerjee, heralded the dawn of better things, of which the work now carried on in the Universities of Bombay and Lucknow is an earnest.

Although the period which has elapsed since the initiation of these facilities for anthropological study has been comparatively brief, it has sufficed to bring out certain difficulties which arise from the extent of the territory to be covered and the scattered distribution of the workers. Notable among these shortcomings was a serious lack of co-ordination and co-operation in both research and instruction. It was felt that if research was to go forward with any measure of success, some centre at which workers from different parts of the country might meet for discussion and interchange of views was an imperative need. Only from full and free discussion, it was evident, would it be possible to formulate and give concrete shape to the problems which urgently call for investigation. The leading anthropologists of India thereupon decided to form an Indian Anthropological Institute, at which such meetings and discussions might take place. This was inaugurated in 1936, with Dr. J. H. Hutton as its first president, and a number of prominent anthropologists from different parts of India as the first members of its Council.

It is obvious that an institute of this character, founded and maintained on broad and catholic lines, should be in a position to exert a dominant influence in determining the future development of anthropological studies in India. It promises well that certain fields which are in urgent need of research, certain departments of investigation in which there are defects of organization urgently calling for reform, have already been indicated as demanding the consideration of the Institute's members, and it may be hoped that this will also arouse the interest of a wider public.

It was unfortunate that the foundation of the Institute took place only a short time before Dr. Hutton's retirement from the Civil Service and his departure from India. His many years' experience of ethnographical survey work among primitive peoples under the Government of Assam, as well as his organization and superintendence of the Census of India, 1931, gave him a knowledge of the problems of Indian ethnology

which is unrivalled among anthropologists of to-day. This knowledge would have been of inestimable value in shaping and carrying out a policy of development in anthropological research in India. Dr. Hutton himself has not been without recognition of his responsibilities; and in his presidential address to the Institute, written towards the close of 1938 after his return to England, and in the nature of both an inaugural message and a valediction, he has wisely taken advantage of the opportunity thus offered him to suggest briefly the lines upon which the future work of the Institute might be carried on in relation to the organization of scientific study of the problems of anthropology in India.

No one is more fully aware than Dr. Hutton of the difficulties which lie in the way—the vast distances, and the differences of language, of temperament and even of script, which hinder co-operation among anthropological workers in India; but he suggests that these very difficulties make it all the more imperative that anthropologists should co-operate in a science "which can do more than any other branch of study to resolve into a homogeneous unit the racial, cultural, and temperamental diversities inevitable in the inhabitants of so great an area and such varying environments". Indeed, when he goes on to enumerate the subjects which urgently demand investigation, he points out how this very diversity in the peculiar social conditions of India provides a field more favourable to investigation than any other extant.

Nor is the question one of purely domestic concern to India alone, for, as Dr. Hutton justly adds, it may provide the solution of problems of world-wide application. Caste, for example, affords an unrivalled field for research, in that it preserves better than any other institution the pure genetic line and hence, owing to the wide and varied field of distribution, provides exceptional material for the study of the effect of different geographical and climatic environments on physical characters, on successive generations, and, in relation to the study of heredity, on individual aptitudes, on the inheritance of acquired characters, and a number of other cognate problems—in short, it opens up an opportunity for the full investigation of the effects of isolation on human groups, physically, psychologically and culturally. A further matter which is stressed, and is of more than local interest, is the need for detailed monographs on the aboriginal tribes and other groups, of which the lack severely circumscribes the study of Indian ethnology in the English universities.

Passing over other problems of research, upon which Dr. Hutton touches, as matters of technical rather than general interest, there is one question commended to the care and attention of the Institute which is vital for the future successful pursuit of these studies. This is the supply of trained men, though in this connexion Dr. Hutton speaks more especially with reference to the needs of museum work. If the efforts of the Institute in this direction are to be of any avail, it is scarcely necessary to point out that the closest co-operation with the universities must be secured, as well as an increased recognition among academic bodies that additional facilities for these studies will have to be provided.

On one aspect of anthropological studies and research Dr. Hutton, in addressing a body of scientific men, did not dwell. In speaking of the need for a linguistic survey of languages south of the Godavery—a need upon which all anthropologists in India are agreed, and of which the lack is a serious bar to successful research—the need for ethnographical monographs on the aboriginal tribes, for the study of caste in its various aspects, and the like, the plea for study of all these problems might well be reinforced by stressing their practical bearing on the work of administration, and their value, if not indeed their vital necessity, for successful government, under the new constitution, of peoples in whom racial, social and traditional differences run deep.

However much it may be felt that the study of the modern peoples of India falls short of the merits of its intrinsic interest, there are those who think that the investigation of its past civilizations is in an even more parlous state. In a communication, which appears in the first issue of the Institute's journal, Lieut.-Colonel D. H. Gordon puts forward a grave indictment of those who are responsible for the study of the pre- and proto-historic archæology of India, whether in India itself or outside, more especially since the retirement of Sir John Marshall from the archæological service.

It is evident that Colonel Gordon feels strongly that the position of archæological studies relating to India calls for plain speaking. Nor does he stand alone. It is unnecessary here to enter into a detailed examination of Colonel Gordon's contentions in view of the report prepared

by Sir Leonard Woolley on the results of his recent inspection of the field organization and accomplishment of archæological studies in India, a digest of which is printed on page 758 of this issue of NATURE. Colonel Gordon's views, indeed, lend further emphasis to Sir Leonard's criticisms. Stringent though Sir Leonard's comment may be, especially in dealing with the work of the Archæological Department since the retirement of Sir John Marshall, and drastic as may be the changes advocated, his recommendations are measures of reform, and not revolution. He admits the excellence of the material in the members of the staff, and the learning and enthusiasm which met him everywhere; although the Department has been starved financially, the need of the moment is not the immediate expenditure of more money, but training and experience in both field-work and the museum, combined with differentiation in function of the members of the staff. Hence follows the need for more complete co-operation between the universities and the Archæological Department inside India, and the participation in excavation and research of scientific and learned bodies from without.

Sir Leonard Woolley, as one of the foremost of practical archæologists who have worked on modern lines, has stressed fully the principle that research on the grand scale, such as the importance of the cultural history of man in India demands, is an affair of the close adjustment of preliminary planning, field-work exactly carried out and precisely recorded, and the further analysis and study of the immediate results in the archæologist's laboratory—the museum—followed by early and widespread dissemination through prompt publication in appropriate form.

Opinion in India no doubt will be divided on Sir Leonard's recommendation that skilled assistance should be brought in from outside for a period to organize archæological studies. Yet in view of recent advances in technique and the wide field to be covered, especially in the earlier stages of prehistory, it would be difficult to ensure speedily a sound foundation for an Indian school of archæology by any other means at present.

For the moment, reforms must stand in abeyance; but even so it is not too soon to plan for the future. India is entering upon a new phase of its history. Could a more fitting memorial of that event be found than the institution of an organization for research which, in course of time, would build up worthily a comprehensive panorama of the development of the civilizations of India from the very earliest times down to the present day?

YOUTH AND NATIONAL SERVICE

The Needs of Youth

A Report made to King George's Jubilee Trust Fund. By Dr. A. E. Morgan. Pp. xi + 434 + 8 plates. (London: Oxford University Press, 1939.) 10s. net.

THE raising of the school-leaving age is only one of the factors which in recent years have directed special attention to the welfare of the adolescent. Reports from the Commissioners for the Special Areas have evinced concern at the effect of prolonged unemployment on the juvenile worker, and the situation has prompted attempts at amelioration such as the juvenile transference scheme and the junior instruction centres. Social surveys, such as the work of the Social Science Department of the University of Liverpool on population problems of new estates, have directed attention to educational and labour problems involved in the decline of the juvenile population, and to the need for industry to concern itself more closely with questions of recruitment. The annual reports of the Chief Inspector of Factories continue to emphasize the alarming proportion of preventable accidents among young workers, and the need for greater training and care for the young recruit to industry. The question has also been examined from the point of view of nutrition, as in the University of Bristol social survey of the standard of living in Bristol, or of general physical fitness from the point of view of the National Fitness Council, or the demands of national service. The present concern with the question of juvenile delinquency is yet a further factor, possibly less serious than some are inclined to fear.

In all such approaches, however, the welfare of the adolescent has been considered primarily from the point of view of the needs of the community if not rather of some special section of it. Even if we concede that the Education Act, 1936, was

prompted mainly by a desire to safeguard the interests of the adolescent, it must be admitted that few, if any, authorities on education are satisfied with a measure which stops short of raising the school-leaving age to sixteen years, with provision for part-time training up to eighteen years. Moreover, however conscientiously the Act is administered, there has been evidence, in the applications for exemption, of failure once again to realize that the adolescents of the nation are ultimately more important than any industry.

The report which Dr. A. E. Morgan has recently prepared for the King George's Jubilee Trust Fund is thus opportune. Dr. Morgan reviews social, educational, industrial and recreational conditions in so far as they touch the adolescent, and his impartial and scientific survey, if it makes no claim to be a piece of sociological research, permits in any event an attempt at a coherent and comprehensive statement of the needs of youth in Great Britain to-day. Moreover, he contrives in his survey to give a picture of the life of youth in great industrial cities which is as welcome for its human appeal as for its challenge to constructive planning and resolute action.

One of the great merits of this survey is that it views the problem and the needs of youth as a part of the general problem of national welfare. Only on the bedrock of youth, Dr. Morgan asserts, can we lay the foundations of real national fitness. If under the specious plea of the needs of any particular industry, through the opposition of any vested interest, or even the demands of national defence, we allow the physique or morale of youth to be damaged, we are in danger of finding that not merely industry but also the nation as a whole is impoverished. There is a point beyond which the enforcement of economy at the expense of youth, even at the behest of national defence, may vitiate or nullify that last colossal effort.

The favourable comments on the first militiamen have often failed to direct attention to the debt owed to the extension of education to cover every kind of social service to the child. The schools are not only training the mind and body of the child, they are eradicating the results of the hectic industrialization of the nineteenth century. Extension of education to cover recreation, medical inspection and treatment, physical training and introduction to the use of leisure is only rectifying some of the great social injustices of the past.

If, for example, we see in the quality of mind and body revealed by recruits of the former militia some of the fruits of educational policy and expenditure, Dr. Morgan's book indicates how great the need still is, and the grave danger that in the years of unguided or unhelped adolescence, serious damage may be done alike to the physical, mental or moral development of youth which will prevent the full benefits of educational advance being reaped. Even on the educational side, the Education Act of 1936, however conscientiously administered, does not take us far enough. The nation cannot be said to be taking the care of its children seriously until the school-leaving age is raised to sixteen years. Even at sixteen we cannot afford to let the boy or girl step out of our care. The imminent decline in the adolescent population might well impel us now to take steps to prevent further invaluable human capital running to waste by insisting on a system of part-time continued education during the working day up to the age of eighteen years.

Next to this insistence on the need for providing for further education, at least part-time education, up to the age of eighteen, and for resisting any financial or industrial pressure that might endanger the interests of youth, Dr. Morgan stresses the need for much more careful provision for training and selection for a job and for dealing with the blind alley difficulty as well as with the serious problem of juvenile unemployment, so as to prevent both physical and moral deterioration. Similarly, juvenile delinquency is to be regarded as essentially an educational problem, the successful handling of which is an educational process.

Moreover, it is not merely in the actual training for a particular occupation and the selection of individuals for a job for which they are suited that closer attention to the needs of youth is required. Definite exclusion of youth from occupations which from their nature are unsuited requires extension. Much more could be done to reduce or prevent the alarming incidence of accidents among young persons entering industry. This involves not merely more careful training and instruction of the entrant to industry, and the placing of the accident-prone in jobs which are free from hazards; it involves also education of management and employers to a fuller sense of responsibility. Nutrition, hygiene, medical care—these are all matters where extension of provisions or services for the school child to the young worker in his or her first trying and formative years in industry might be as sound an investment from the national point of view as it is socially desirable.

These are fields in which many scientific workers, by virtue of their managerial responsibilities or professional knowledge, may well be able to assist. When, however, Dr. Morgan proceeds to the discussion of the needs of youth in leisure and recreation and the means of meeting these needs, he raises a number of questions which are of the widest interest and significance. For

all but a small minority who find expression in their vocation, workers as a whole look outside their labour for the expression of their lives. In our modern civilization, work has largely ceased to be an absorbing means of expression and is sought merely as the device by which we get the money wherewith to buy the things we desire. The hours of work are suffered for the sake of the reward which is to be reaped thereafter.

This salient factor, which the scientific worker is liable to overlook, gives special significance to the right use of leisure, above all when the tendency is to decrease the hours of work. Even adult education, for a quarter of a century claiming to be designed not for livelihood but for life, has emphasized this gulf which separates work and living. Moreover, with this search for real life outside work, leisure has largely become commercialized with debasement of artistic and other standards, while the functions of leisure have been widened and the need for its proper use enhanced.

The difficulties are increased by the confusion introduced by the false emphasis placed on freedom, particularly at a time when a democracy is especially nervous of anything which threatens the sacred principle of liberty. Ultimately, leisure must be a voluntary pastime. It is the means of expressing the vital aspect of human capacity, and as such must be free. Like any other human faculty, however, the capacity for recreation needs education, and the process of training involves compulsion. Again, while work may narrow with increasing specialization, the scope of leisure occupation is as wide as life itself, and even within the compulsory stage training must give the widest options.

These considerations lead Dr. Morgan to place his main emphasis on the need for leadership. This is a dominant factor in guiding and training youth so that its dormant faculties find normal and healthy expression, whether in physical recreation, in hobbies and pastimes, or whether, as in the 'Young Farmers' Clubs' in the union of vocational education with recreation, thus contributing to the solution of that major social problem of our time, the divorce of work and leisure. The value of the great majority of juvenile organizations, such as boys' and girls' clubs, depends on the right quality of leadership being available, and even in various community centres, facilities are being neglected and wasted for lack of leaders to manage and lead them. Moreover, when local authorities are actively assisting juvenile organizations and providing facilities, they are often unacquainted with the practice of other authorities. No one appears to have made a survey of the situation, and the Board of Education itself is without comprehensive information.

This matter of co-ordination and further survey of actual practice calls for further investigation, either by a group such as Political and Economic Planning or by the social science departments of the universities.

The general question of leadership, however, touches scientific workers generally even more clearly. It is not merely that the training which they have received carries with it certain social responsibilities, and that by virtue of their training the proportion of leaders should naturally be higher than in classes which have not been so highly trained or educated. The traditional source of supply for club leaders has been the young men and women of the better-to-do classes, whose sense of social responsibility urged them to devote time, and often money as well, to the welfare of the less privileged. The universal difficulty of recruiting enough help is an indication of a lack of social sense and responsibility to-day, and our educational system might well do more to impart such a sense of social responsibility. Leaders are in fact being recruited from every walk of life, but the significant fact to which Dr. Morgan directs attention is that leaders can now no longer be secured in sufficient numbers on a voluntary basis.

At present, the number of paid leaders is small, but boys' clubs must face the fact they will depend more and more on professional service, and the practical problem is to ensure that it is of the right kind. The basic difficulty is that imposed by the limited financial resources of such clubs. A club leader should have had a good education and some professional training. Much is expected of such leaders, but rarely is a boys' club in a position to offer a salary of more than £200 a year.

Dr. Morgan insists that we must recognize that club leadership is a profession and must be remunerated properly if the right men are to be forthcoming. He suggests it is essentially educational, and that local education authorities might well be persuaded to make far more grants to the voluntary movements for this purpose. Recognizing that even with this help there are limitations to the remuneration which could be expected, he suggests that more could be done to make such work a stepping-stone or stage to other careers whether in teaching, in industrial welfare work, probation service and the like, where the experience gained should be an asset.

Certain obstacles would have to be overcome. Such work must receive full recognition in regard to security and pension rights. Closer attention must be given to the training of entrants for such positions, and in this the social science departments of the universities might well co-operate.

As this tendency develops, it might open up careers for those taking a diploma in social science or pursuing a short course of social research, provided they possessed the essential qualities of leadership.

Here are suggestions which should be welcome to many scientific workers who are turning their attention to social problems. For some of them the voluntary work which will long be required may offer an opportunity for the expression of their sense of social responsibility, and for maintaining or even raising the standard of leadership. Others may find a like opportunity in the social surveys and investigations which are still necessary to render further information available as a basis for the national action required. For all, however, there is the opportunity to assist by pressing for adequate attention to the problem by local and national educational authorities, by supporting with their active interest such work as is already being carried out in this field by the universities, by bringing sympathy and insight and creative thought to bear on the problems which the needs of youth present to-day. Nor should scientific workers be unmindful of their responsibility as citizens to protest against any hesitation by public authorities to exercise their powers of compulsion to stop certain abuses which at present, as Dr. Morgan so clearly shows, are detrimental to both the health and morale of youth, and, in effect, squander capital which grows the more precious in a time of emergency. R. BRIGHTMAN.

PLANETS AND SUNSPOTS

Tidal Forces in the Sun's Corona due to Planets
By K. G. Meldahl. Pp. 14+7 plates. (Copenhagen: Berlingske Forlag, 1938.) n.p.

THE author of this work believes that radiation pressure on certain small particles in the corona should balance gravitation so closely that a 'sensitive layer' exists. If this is disturbed, it will undergo violent motion and probably ejection. The force likely to produce the disturbances is the tidal action due to the planets, and though this is too weak to cause any noticeable motion in the heavier, luminous portion of the sun's gases, nevertheless, as the hydrogen prominences appear at a level comparable in height to the altitude of the 'sensitive layer', it is important to seek for some connexion between the disturbances and tidal forces. Only five planets need be considered to contribute anything of importance to the tidal force—Mercury, Venus, Earth, Jupiter and Saturn. Mercury, though very small, must be taken into account because the tidal force varies inversely as the cube of the distance of the planet from the sun; Mars is neglected as its tidal force is only about 3 per cent that of the earth. The five tidal forces are added vectorially, the resultant vector giving the height h of the force wave running round the equator, and the main investigation is carried out on these lines.

The period of Mercury is close to 88 days, and for this reason diagrams of vectorial additions for every eleventh day are drawn from 1663 to 1966 to test for periodicities. It does not appear that the period of Jupiter or the longer secular period of the three inner planets taken together is concerned, but a period of 243 years is partly noticeable, and a multiple of this seems to be indicated.

Discussing the connexion between the diagrams and the observations of disturbances, the author directs attention to two important matters. (1) Where radiation pressure is not constant, an increase in it would drive out the previously balanced particles and bring heavier ones into floating equilibrium, thus facilitating disturbances in the lower layers of the corona. (2) If existing spots increase radiation locally, this provides the possibility for relatively smaller tidal forces to generate disturbances. It will be misleading to compare the periodicity of *observed* spots and group sizes with tidal forces; the latter should be compared with the *genesis* of spots, and the existing spots should generally show a lag.

The mechanism of spot creation is considered to be as follows: Gases of the sensitive layer rotating with the sun at a speed of about 2 km./sec. run through the tidal field of force. At times they encounter forces greater than those that permit quiescent motion, and there ensues a break-up into vortices such as hydrogen prominences. A detailed description is given for the appearances of spots with regard to certain physical features, but it is open to some doubt whether all these are fully explained by the supposed mechanism of spot creation.

The author predicted a number of disturbances recently, which have since been observed, and it is possible that he has opened the door for further investigation into the genesis of sunspots, auroras, magnetic storms, etc. If it is true, as he states, that prominences are started in the corona by external forces and that spots are the consequence, a fruitful field for research lies in this realm.

M. D.

AQUATIC PLANTS OF INDIA AND BURMA

Hand-Book of the Common Water and Marsh Plants of India and Burma, 1936
By K. Biswas and C. C. Calder. (Health Bulletin No. 24: Malaria Bureau No. 11.) Pp. xiii + 140 + 38 plates. (Delhi: Manager of Publications, 1937.) Rs. 2.12 or 5*s*.

THE purpose of this book is to facilitate the field work of those associated with anti-malarial investigations of the breeding places of mosquitoes. It is obvious that a sound knowledge of the plant life found in those localities, their reactions to each other and their relations with the animal life in their surroundings is an important stage in this research.

Brief accounts of the bionomics of freshwater vegetation, general features of aquatic vegetation, periodicity of water plants, methods of control, precede the systematic enumeration of the plants likely to be encountered. The work is not exhaustive, but is intended only to comprise the commoner plants. Short descriptions of the 61 families, 126 genera and 220 species (including Cryptogams) are set out, together with practical keys for the determination of genera and species where necessary. A key to the families would have been helpful to those inexpert in systematic botany.

Six reproductions from photographs of aquatic habitats, and line drawings of 157 of the species or varieties listed are appended. Comparison would have been made easier had the plants of the same family, or at least genus, been juxtaposed. Only in the case of the Cryptogams have the magnifications of the enlargements been stated.

The nomenclature is not in all cases that accepted nowadays by systematists: for example, *Herpestes Monniera* has been retained in place of *Bacopa Monniera* (L.) Wettst., and *Panicum muticum* is given preference over *Brachiaria mutica* (Forsk.) Stapf.

There are a number of errors and omissions; many of these have been corrected in an addendum not bound up with the publication, but others have escaped: for example, at the foot of p. 7, "Whether this . . ." should read "Where this . . ." and *Leersia hexandra* Sw., described on p. 100 and figured on Plate III, is omitted from the index.

The work, however, is generally good and should amply fulfil its object. C. E. C. Fischer.

SOME ASPECTS OF CHEMICAL ENGINEERING

A Practical Manual of Chemical Engineering
By Harold Tongue. Pp. xvi + 560. (London: Chapman and Hall, Ltd., 1939.) 36*s*. net.

A BOOK on chemical engineering published in England is welcome, even if only to show the growing interest in this subject. Mr. Tongue's work does more: it fills, as he claims, a gap in the literature, by dealing with the materials which modern science has placed at our disposal, and methods of using them. It is admittedly a compilation and, as such, it is bound to exhibit a certain lack of balance; for example, under the heading "Wood", with the exception of a table of the mechanical properties of a few American woods, redwood is the only material discussed. Under "Rubber", six pages have been transcribed verbatim from a well-known pamphlet, apparently without acknowledgment—no doubt a slip on the part of the author—and there are other abstracts which, although good in themselves, are often somewhat disconnected.

The chapters dealing with metals and alloys are excellent, and the only criticism which need be made is again a certain lack of co-ordination, the mass of isolated facts tending to produce a sense of confusion. Perhaps in a future edition the author would consider the introduction of a few phase diagrams to explain the interrelations of some of the alloy systems. Since space is important, details of welding procedure might be curtailed, and extraneous matter, such as the uses of platinum as a catalyst, omitted.

The following sections on pressure vessels and piping are up to the high standard which is to be expected from the author of "The Design and Construction of High-Pressure Chemical Plant", and they are followed by a useful chapter on heat insulation and an even more valuable summary of recent data on the economic utilization of power in works. This difficult subject is one which should have more attention than it frequently receives.

At this point the author appears to have realized that the book was becoming too large, and to have attempted the impossible task of crowding heat transfer and a few selected unit processes into two hundred pages. The result is unfortunate, for the theory is inadequate and a great deal of the

remaining matter, although by no means uninteresting, is strongly suggestive of a collection of manufacturers' catalogues. In the section on heat transfer, reading is not made easier by the use of different symbols for the same quantity and, in the chapter on distillation, modern work such as that of Kirschbaum is not mentioned. Under "Filtration", there are no fundamental principles at all. In short, in contrast to the earlier chapters, this part of the book contains little that is not to be found in standard textbooks. It would have been better omitted, or, alternatively, expanded into a second volume, dealing not only with the plant itself, but also with recent research into fundamentals, which is becoming daily more important for the purpose of design.

Any defects in the second half, and they are only defects of omission, are more than compensated by the earlier chapters, which present in a handy form a summary of valuable information collected from sources which are not always readily accessible. As a volume of reference the work should find a place in the library of every chemical engineer. H. E. W.

APPLIED MECHANICS

Proceedings of the Fifth International Congress for Applied Mechanics

Held at Harvard University and the Massachusetts Institute of Technology, Cambridge, Mass., September 12–16, 1938. Edited by J. P. Den Hartog and H. Peters. Pp. xxxii+748. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 30*s*. net.

THIS account of the work of the Fifth International Congress for Applied Mechanics is contained in a volume of 748 pages preceded by preliminary matter including the list of the four hundred members of the Congress. The proceedings consist of general lectures and short papers of about six pages, divided among three groups.

The first group deals with Elasticity and the Properties of Materials. The general lectures by Hardy Cross, Joseph Pérès and F. Körber are reported in full and are followed by forty-four papers about equally divided between theory and experiment. Obviously no summary could do justice to the variety of topics here treated, so we select for special mention, on account of its historical interest, a paper by Hetenyi on photo-elastic studies of three-dimensional problems. In 1850 Clerk Maxwell observed that, if isinglass is loaded at an elevated temperature, after cooling and removal of the load it exhibits, in polarized light, permanent fringes which correspond to an elastic stress condition. Maxwell also concluded that there could not be actual stresses present in the annealed specimen, from which conclusion it would follow that slicing the piece should not change the fringe pattern. From an examination of the slices the stress distribution in a three-dimensional model could be inferred. This final step was not taken until 1935. The paper gives experimental evidence justifying the method of slicing together with some interesting photographs.

The second group, Fluid Mechanics, begins with general lectures by C. H. Chatfield, H. U. Sverdrup and G. I. Taylor, followed by sixty-two papers. The numerical comparison with the first group throws an interesting light on the relative trend of present-day research. Not only so, but of the sixty-two papers, twenty-four deal with turbulence and related problems; indeed, a turbulence symposium was a feature of the Congress. In this group we select for special mention the paper by Norbert Wiener on "The Use of Statistical Theory in the Study of Turbulence". Behind the seeming innocence of this title there lies in this paper the beginning of a more general and systematic method of attacking the important problem of turbulence. The basic theorem is an extension by Wiener of the original ergodic theorem of Birkhoff to include the equi-measure transformation corresponding to the translation groups in space. The importance of this theorem is that it permits us to translate averages over all systems of an ensemble into averages over all points of space for a given system in the ensemble. This theorem, together with the definition of certain specific ensembles, which can be described in detail, and for which every average can be computed, would appear to form a firmer foundation for the examination of turbulence than any which has hitherto been suggested. To complete the picture the abandonment of the hypothesis of the continuous medium will probably be found necessary.

The book concludes with seventeen papers on dynamics and an appendix. The whole volume has been reproduced from typescript. There may be some good reason for preferring this method to ordinary print, but there can be no question that the ragged margins inherent in typescript and the hand-written mathematical symbols are not things of beauty. Nevertheless the volume does give a cross-section of modern research in applied mechanics and is therefore worthy of serious attention. L. M. M-T.

METAMORPHISM AND IGNEOUS ACTION*

By Prof. H. H. Read, F.R.S.,
Imperial College of Science and Technology, London

[THE consideration of the relation between metamorphism and igneous action, which forms the subject of Prof. H. H. Read's presidential address to Section C (Geology), falls into two parts. First, a brief historical summary of the peculiarly national contributions serves to display the wide divergences in opinion on this question. The views of the Rosenbusch school of pure thermal metamorphism are contrasted with the imbibition notions of the French, and the work of Becke of Vienna, the Swiss, Sederholm of Finland and the Americans is reviewed. The classic investigations of George Barrow on zones of progressive regional metamorphism in the Highlands north of Dundee and their causal relation to granitic injections are sympathetically summarized. In the second part of the address, a discussion is presented of the origin of regional metamorphism, that is, of the transformations which have affected large portions of the earth's crust.]

I first note the equivalence, according to Rosenbusch and others, of regional and dynamic metamorphism. The forerunner of the term dynamic metamorphism was Lossen's dislocation-metamorphism, a simple expression denoting a transformation genetically connected with dislocations of the crust. Lossen's old term would cover a large class of phenomena, such as the dominantly mechanical breaking-down of rocks, cataclasis, mylonitization and the like, all connected with demonstrable dislocations. I propose to continue to use dislocation-metamorphism for this class of phenomena.

Rosenbusch, having replaced Lossen's excellent term by his dynamic metamorphism, proceeded to make this the equivalent of regional metamorphism, and to regard orogenic pressure as its cause. Backed by the authority of Rosenbusch, dynamic metamorphism became fashionable, the dynamic aspect overshadowed all others and mountain-building movements could do all things requisite and necessary. It must be remembered, however, that many of the French were frankly sceptical; nevertheless, the notion of a metamorphism on a regional scale "induced in rocks because of their deformation" remains still a leading principle in many schools of metamorphic geology.

* From the presidential address prepared for Section C (Geology) of the British Association.

On the other hand, the emergence of ideas on a static or load metamorphism of regional extent, in which orogenic pressure is not a causal condition, indicates that all is not well with the supposed equivalence of dynamic and regional metamorphisms. Before discussing static metamorphism itself, I deal with some of the difficulties raised by this equivalence.

I mention certain facts commonly observed in regionally metamorphosed rocks but difficult to reconcile with the operation of pressures tangential to the earth's surface. One of the chief of these observations is the coincidence of schistosity and bedding. As metamorphic rocks showing this coincidence are often horizontal over great areas, the notion of static or load metamorphism has been put forward. But Daly has cited a score of regions where schistosity and bedding agree—in folded and horizontal rocks alike. These are the phenomena that Daly felt to be "truly inexplicable by pure dynamic metamorphism", an opinion with which I am in complete accord.

The preservation of original textures in rocks that have been completely recrystallized is a matter of common observation. There are innumerable examples of the preservation in regionally metamorphosed rocks of minute sedimentation-characters, such as graded bedding, current bedding, the interlamination of undisturbed, exceedingly thin, beds, and so forth—characters that should have been obliterated by the action of orogenic pressures. As an instance of how excellent this preservation may be, I may recall the successful use of current bedding and graded bedding in unravelling the stratigraphical sequence in the Grampian Highlands. An additional and telling example is the recognition of varved bedding in the metamorphic rocks of Finland and Canada. It seems to me that such details of original textures cannot possibly be preserved if the rocks in which they occur were metamorphosed "because of their deformation". I admit, of course, the operation of dynamic action in the production of various metamorphic rocks of low grade, but in these cases the original primary textures are completely obliterated. This obliteration in low-grade metamorphism and preservation in high-grade metamorphism of original textures shake my faith in the unity of the progressive series from the chlorite zone or epizone to zones of higher grade.

Whilst stress is admittedly the dominant factor in the production of low-grade metamorphic rocks, there is agreement that its effect is small in the higher grades, where the products of regional and thermal metamorphisms converge, high temperatures being in control. There is no correspondence between the degree of deformation and the metamorphic grade, unless it be one of the greater the deformation the lower the grade. In this connexion, I may cite the failure of experimental work, like that of Larsen and Bridgman, to produce minerals characteristic of rocks supposedly formed by dynamic metamorphism. Stress, by itself, is not enough.

No one can dispute the observed fact that regionally metamorphosed rocks are often more or less violently folded. The inference so often made that the metamorphism and the folding are coeval is not, however, always justified. It seems to me clear that most fold-structures in regionally metamorphosed rocks ante-date the crystallization, this being post-tectonic in the terminology of Sander.

It will be realized, I trust, that there are many features of regional metamorphism that are incompatible with dynamic action. The recognition of this has led to the invocation of static or load metamorphism, and I examine the validity of this notion.

One of the especial difficulties that has to be faced by advocates of a metamorphism due to the vertical pressure of the overlying beds is the existence of completely non-metamorphic rocks which have nevertheless been covered by an immense thickness of superincumbent strata.

This difficulty confronting static metamorphism has been tackled by Daly, who meets it by relaxing the rigidity of the doctrine of uniformitarianism. He admits that, compared with its proposed potency in Pre-Cambrian times, load-metamorphism must have been of relatively little importance in later geological eras. To account for this, he assumes that the earth's thermal gradient was steeper during the formation of the Pre-Cambrian so that regional metamorphism under a moderate cover was possible. I am not competent to discuss Daly's speculation, and I have only to state that I feel that the proposal does not strengthen the case for regional static metamorphism.

The idea of a metamorphism controlled by load, as such, fails to meet many other observations. I have space here only to cite the occurrence, in the eastern United States, of highly metamorphosed stratigraphically younger beds resting naturally on lowly metamorphosed stratigraphically older beds; of high-grade sillimanite-zone rocks overlying lower-grade rocks as in Sutherland and Norway; of the passage, in Banffshire, from slates to metamorphosed rocks containing andalusite, garnet, cordierite, sillimanite and staurolite within a half-mile of coast-section; of a similar narrow restriction in the Barrovian zones as in Dutchess County, New York. Load, by itself, is not enough.

The literature of regional metamorphism abounds in references to the great depths within the crust at which such metamorphism takes place. These suggestions of great depths, however, carry no kind of conviction to my mind. On the contrary, I consider that high-grade regionally metamorphosed rocks must have been formed in many areas under relatively little cover. Daly was of this opinion, too, and he was influenced thereby in his idea that thermal conditions were different in Pre-Cambrian time from what they were in Palæozoic time. He pointed out that from Clarke's data it is possible to form a rough estimate of the total amount of rock eroded in geological time, and that only a small portion of this amount can be assigned to Pre-Cambrian time. Of this small portion, part is represented in the non-metamorphic Pre-Cambrian sediments which lie unconformably on the metamorphosed basement. The several complexes of the basement were highly metamorphic before the denudations corresponding to the unconformities which separate them. From a consideration of these points, and of the great volume of Pre-Cambrian rocks, Daly concludes that the average cover on the complexes at the time of their metamorphism was much less than 5,000 metres in thickness. Barrell came to a similar conclusion by an argument based upon the amount of salt in the sea, and the erosion of the igneous rocks to give this. He decided that Pre-Cambrian erosion had removed a cover of less than a mile in thickness.

Though these arguments may not appear altogether sound to some, still I suspect that the notion of the great depths of regional metamorphism flourishes because of the supposed necessity of carrying rocks *down* to be metamorphosed. I suggest that as an alternative we should consider the possibility of bringing the metamorphosing agents *up*.

I next discuss certain aspects of the zonal notion, especially in connexion with a depth-control.

I note the development of ideas on depth-zones and, in connexion with static and load metamorphism, I direct attention to difficulties encountered in regarding grade of metamorphism as directly controlled by depth. Admittedly, metamorphism does often increase in grade with depth, but, as I have said in another place, I personally find no difficulty in envisaging a metamorphism which increases laterally or vertically; I consider depth, as such, not to be a factor in metamorphism.

and that if we are to retain a zonal notion, then the idea of depth-control must be completely disregarded.

The relation between the large-scale tectonics and the metamorphic zones in the Highlands is a question which, in the present state of our knowledge, bristles with difficulties. The Cambridge School considers that the metamorphism is pre-tectonic, and that the metamorphic zones can be recumbently folded. On the other hand, Bailey and others regard the metamorphism as partly contemporaneous with the folding. For my part, I suggest that the metamorphism may be post-tectonic. Both in the Highlands and elsewhere it seems to me that the isograde lines are independent of both stratigraphical and tectonic arrangements, and I prefer to relate regional metamorphism not to load, nor to deformation, nor to tectonic or any other depth.

I have pointed out the destruction of sedimentary structures in low-grade metamorphism and their apparent perfect preservation in high-grade metamorphism. If these are valid observations, then it seems to me that the progressive series from slates to higher-grade rocks must break down, or, at least, that high-grade rocks were not necessarily at one stage of their career in the condition represented by the lowest-grade rocks of the zonal series. Low-grade rocks may once have been high-grade, but the reverse is not necessarily true.

(*To be continued.*)

REACTIONS OF ACCLIMATIZATION AND OF NON-ADAPTATION

By Prof. M. Piery and Prof. J. Enselme,
Faculty of Medicine, Lyons

Up to the present time, physiologists have been especially concerned with the study of the acute effects of high altitudes or of acute mountain sickness. As a consequence of the work of Prof. Monge of Lima, who both discovered and studied chronic mountain sickness as manifested in human beings, we, in our turn, have investigated the experimental effects of high altitudes on animals. We believe that in this way we may be able to discover more about the mechanism of adaptation of organisms to altitude, and thus explain the pathogenesis of Carlos Monge's disease.

With this object in view, we studied the effects produced in various animals by a sojourn of six months in the laboratory of the Jungfraujoch, at an altitude of 3457 metres. We have already described elsewhere the technical methods and detailed observations which we have made in this experiment. Here, our object is to give expression to certain views which we hold relating to the adaptation of the animal organism to the lower atmospheric pressures of high altitudes.

The problem of the effects of altitude upon animal organisms gains considerably in depth and interest if, by exceeding certain limits which are usually accepted, we consider it from a more general point of view.

In order to do so, the following facts must first of all be taken into account:

(1) The problem constitutes a particular case of the much wider problem of adaptation in general; it is the case of adaptation to the lowering of atmospheric pressure.

(2) It consists of several biological stages which, like all adaptations, may be schematized as follows:

(*a*) A tissue forms the receptive element for the external influence. Sometimes this is the skin, sometimes the digestive organs and, in this particular case, the lungs.

(*b*) The effects there are carried by a transmission system into the innermost tissues and set up a connexion between the receptive tissue and the whole of the organism. This transmission system consists of two physiological pathways, a neuro-vegetative action, adrenergic or cholinergic, or alternatively in the form of an action of a chemical messenger.

(*c*) A system of tissue reception which affects the various organs and those elements of inter-tissue synthesis; namely, the glands of internal secretion.

(*d*) A mechanism of genetic transmission, the reaction of the genital elements.

(3) Furthermore, in the case of each one of these components, the following must be distinguished:

(*a*) The modifications which appear as direct effects of the climatic change: as, for example, the modification of the tissues by chemical or mechanical influences.

(*b*) A number of reactions which are not so

easily explained and which are called defensive reactions because they permit of the survival of the tissues. These constitute the actual basis of the phenomena of adaptation.

(4) The adaptation thus effected constitutes a new form of state of the organism which, in order to return to its previous state, must pass once more through the same stages.

These principles set forth, we will now proceed to apply them to the problem with which we are concerned, namely, that of adaptation to the lower atmospheric pressure of high altitudes. And here, we propose to divide the subject as follows:

Effects of Reduced Pressure on an Organ Sensitive to Climatic Anomaly

Here, climatic anomaly is constituted by the drop in the partial tension both of the oxygen and of the carbon dioxide in the air inhaled; and consequently in the alveolar air. The sensitive organ here is the lung.

The effect of this lowering appears to be a congested state such as we have witnessed in rabbits and geese which have spent six months in the laboratory at the Jungfraujoch. This congested state is characterized by a decided vaso-dilatation of the inter-alveolar capillaries. A large number of alveoli contain red corpuscles, and some of them contain, in addition, alveolar cells in process of desquamation. These lesions have no characteristic localization. There is no indication either of inflammatory cells or of the presence of fibrin in the alveoli.

The importance of these lesions varies according to the subject. In order to estimate them to the best advantage we conducted, on one hand, a histological examination of the lungs; and, on the other, we administered doses of iron to the entire organism. The results given by the two methods appear to agree with one another.

These lesions appear to aggravate further the difficulties experienced by oxygen in passing through the walls of the pulmonary alveoli. Their action is of the same kind as that of the diminution of the partial tension of oxygen in the alveolar air. They thus appear to act in the same direction as the reduction of atmospheric pressure and to increase the disturbances which it evokes. In addition, we observed that these lesions actually lower the oxygen saturation of arterial blood.

On the other hand, a defence reaction which tends to correct the abnormal phenomena evoked by the lowering of pressure is observed. This defence reaction consists of an unfolding of those alveoli which have not, as yet, been utilized; and of a polypnœa which renews the alveolar air more rapidly and thus contributes to a slight rise in the partial tension of the oxygen in the alveoli.

Disturbances at the Level of the Systems of Transmission

We have already seen that it is convenient to distinguish two systems.

(1) The system of neuro-vegetative transmission responds to the excitation evoked by reduction of atmospheric pressure and to the lowering of the blood oxygen by tachycardia, which permits of a more rapid circulation of arterial blood and consequently of transmission of oxygen. Furthermore, a reflex produces a splenic reaction which throws a large number of red corpuscles, oxygen carriers, into the circulation. These ensure the most complete circulation of oxygen.

(2) The system of chemical messengers shows two types of reaction:

(*a*) An inevitable chemical effect of the lowering of the partial pressure of alveolar oxygen is the fall in the oxygen saturation of the blood. This, in any event, represents a classical idea which we re-discovered in the case of the rabbits in the Jungfraujoch laboratory, among which the average was 77, while that of the control animals was 91.

Another result of the same type is the marked drop in the total quantity of carbon dioxide in the blood. Lowering of the partial pressure of the alveolar carbon dioxide has also been described; and we found it again. Actually, our rabbits showed an average of 29·6 for total blood carbon dioxide, while the controls gave an average of 42·78.

(*b*) The defensive reaction of the organism is shown by a hyperactivity of the hæmatopoietic centres, which throw a large number of corpuscles, usually of the smaller kind, into the circulation and thus increase the surface of absorption reserved for hæmoglobin. The average number of red corpuscles in a rabbit is about 4,300,000; in the experimental rabbits it increased to a total of 6,978,000. An important increase in the oxygen capacity of the blood ensues; and while among the animals experimented upon in Lyons this capacity was represented by an average of 12, in those at the Jungfraujoch it increased to 19.

In another connexion, the lowering of the carbon dioxide of the blood effects a lowering of the alkaline reserves. Compensation for this is obtained by an increase of certain buffer systems.

Disturbances of the Tissues

Disturbances of the tissues are manifold. In a general sense they correspond to the phenomena of anoxia and acapnia. The phenomena of anoxia are distinguished, in every part of the organism, by chemical modifications, such as the lowering of the basal metabolism and the increase of lipides or of cholesterol. They become more easily recognizable when they affect special organs.

(1) We made a special study of muscle, and while in rabbits generally we found equal amounts of muscle iron, in those animals which had been in the Jungfraujoch laboratory we observed a marked decrease in the quantity of the iron. We are of the opinion that during the first months of adaptation, a diminution in exchanges, together with a lowering of the iron content, takes place. This irregularity soon passes off. Clinically speaking, muscular anoxia is expressed in the form of asthenia and disturbances of a painful nature.

(2) The liver also has occupied our attention to a large extent. In our rabbits, the iron increased. We are of the opinion that this constitutes a first defence reaction against anoxia, the iron playing the part of an active agent of oxidation. Hepatic anoxia is expressed clinically by the characteristic signs of insufficiency of the organ.

(3) The heart very often gives rise to acute symptoms, and in our animals we observed, histologically, traces of sclerosis.

(4) Finally, a number of other organs are also affected, such as the nervous centres or the kidneys; but histologically, in the case of our animals, no lesions were visible.

Conclusions

In this preliminary study, we have considered the mechanisms of adaptation at an altitude of about 3,500 metres as observed during a sojourn of six months' duration. We have observed the gradual development of a certain number of these mechanisms. The observations which we were able to make on the constitution of the blood have only served to confirm data that had already become classical. On the other hand, the observations which we were able to make on the tissues, lungs, muscle and liver, give rise to a number of new conceptions. For example, in the lung, phenomena of congestion appear which seem to aggravate the anoxæmia, while in the liver and muscles, variations in the iron content seem to be in accordance with adaptation to anoxia.

It remains now to distinguish among the facts which have been observed and described above; those which arise from a successful adaptation—that is to say, from successful acclimatization—and those which in the animal correspond to the chronic mountain sickness manifested in human beings.

In this connexion, non-adaptation to lowering of atmospheric pressure is accompanied by congestion and capillarization of the lungs, by a drop in the oxygen saturation of the blood, by a marked lowering of the total quantity of the carbon dioxide of the blood, by the diminution of the alkaline reserves, by the diminution in muscular iron, and finally, a light sclerosis of the myocardium. On the other hand, the phenomena of effective adaptation give rise to polypnœa, to the unfolding of the alveoli, to emphysema, to increased activity of the hæmatopoietic centres, to an increase in the oxygen capacity of the blood, to the growth of certain buffer systems and finally to an increase of iron in the liver.

Thus our analysis, both chemical and histological, results in arguments in favour of the idea of a complex response of the organism to anoxæmia and of the existence of manifold reactions of acclimatization. It now remains to apply to man the experimental observations which we have carried out on animals. This we hope to be able to do at some future date.

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NUTRITION DURING WAR-TIME

By Sir John Boyd Orr, F.R.S.

THE new science of nutrition has raised issues which profoundly affect the economic and social structure of the State. During the last few years, the agricultural, trade, health and social aspects of these issues have been studied by various groups of investigators, and arrangements were made by the Division for the Social and International Relations of Science for a discussion of the subject at the British Association meeting at Dundee on September 8. Owing to the outbreak of war, the discussion did not take place. The results of the investigations promoted by Government committees, research institutes and other organizations in recent years will now prove invaluable to those adjusting the national food supply to war needs.

These studies of the food position have clarified ideas. It is now common knowledge that a great

deal of disease, ill-health and physical disability, which in the past were regarded as normal and inevitable, are due to faulty diet and, therefore, preventable. We now know the kind of diet needed for health. The British Medical Association standard was calculated to be good enough to prevent obvious clinical signs of malnutrition. According to the results of Sir William Crawford's survey, which agrees closely with the results of other investigations, there are nearly nine million of the population of Great Britain whose diet is below that standard. But there is a great difference between the mere absence of disease and full vigorous health, which is provided for in the higher standard of the League of Nations Nutrition Committee. The diet of nearly half the population does not come up to this higher standard. Quality of diet is correlated with income. Dietary and health surveys have shown that as family income falls the diet becomes worse, and ill-health and poor physique become more prevalent. The infant mortality rate is three times as high among the very poor as among the wealthy. The incidence of disease attributable to faulty diet is several times as high, and the average adult stature is three to four inches less.

In addition to poor diet, there are, of course, other factors associated with poverty, especially bad housing and psychological factors which affect health. It is difficult to assess the relative importance of these, but there is no doubt about their combined effect on health. As the Right Hon. Mr. Bruce has put it: "Poverty is directly correlated with ill-health, disease and premature death."

It used to be assumed that the poor represented an inferior strain of the population and that the high infantile mortality among the poor was Nature's salutary method of eliminating the unfit. This view, which would absolve us from doing anything to abolish poverty, is not supported by facts. Where the infantile mortality rate is highest, the survivors are of poorest physique and vice versa. The factors which make for high infantile mortality seem to be the same factors which make for ill-health and poor physique among the survivors. There is no doubt about the importance of heredity, but we cannot dogmatize about inherited difference in health and physical fitness between the well-to-do and the poor until environmental conditions affecting health and physique are comparable in both classes.

Of these environmental factors, nutrition seems to be of prime importance, because the results of feeding tests show that when the diet of the children of the poorer classes is improved, making it more like that of the well-to-do, the rate of growth of children approaches that of children of the well-to-do classes, and there is a noteworthy improvement in health and physique. In the last twenty-five years, there has been a remarkable improvement in the national dietary. Consumption of 'protective' foods has increased by nearly fifty per cent; there has been an accompanying improvement in national health and physique; infant mortality rate has fallen by nearly fifty per cent; the gross forms of deficiency diseases, such as rickets, are rapidly disappearing; deaths from tuberculosis, resistance to which has increased by good diet, has been reduced by nearly fifty per cent; children leaving school to-day are two to three inches taller than their parents at the same age. What has been done shows how easily life could be saved and life and happiness increased. It affords complete justification for the public health and social services which have made the 'protective' foods, especially milk, available, free or at reduced prices, to necessitous mothers and children.

Although such a remarkable improvement has taken place, we are still far from our goal, which is an adequate diet for every member of the community, however poor. In the United States, the British Dominions and other countries, where investigations have been done, the position is not markedly dissimilar to what it is in Great Britain. National health and physique, especially of the poorer classes, is far below what it would be if the new knowledge of nutrition were fully applied. This opens up a glorious vista for the future. Even in the most advanced countries, man has not yet attained his full capacity for health and physical fitness. We have the knowledge and we can provide the means for a further great advance in human welfare. Rapid improvements have been made in Great Britain and elsewhere, and, in an atmosphere of increasing good will, schemes were maturing for adjusting national food policies to provide diets for the whole community on the standard now known to be necessary for health.

It would be disastrous if this work were pushed into the background as being of minor importance in war-time. As a matter of fact, the nutrition problem becomes even more urgent in war. This will continue to be a war of nerves, and the issue may well depend upon whether or not the people are able to withstand the physical and mental strain of war. Malnutrition, due to lack of 'protective' foods, leads to lack of capacity for sustained physical and mental effort, apathy and despondency, all factors which make for fear and a spirit of defeatism. For maintaining the will to victory in this war for liberty, the quality of the national diet is as important as the quantity. Our aim should be to accelerate the remarkable improvement in diet and accompanying improvement in health of the last few years.

Fortunately, the food policy for war is the same as the food policy needed for peace, namely, increased production and consumption of 'protective' foods. Food defence, in addition to providing stores of wheat, sugar, fats and other foods, and organizing distribution and rationing, must consider the question of what additional foodstuffs agriculture must produce to maintain and improve the national diet. Yield of protein, vitamins and minerals per acre must be considered as well as yield of calories.

This is one of the war measures for which we need not grudge expense. A war food policy, designed to increase the health and vigour of the population and to adjust agriculture and trade in foods to the needs of the population, will leave a national asset which will be invaluable in the reconstruction period after the war for world freedom is won. There is here a great opportunity for the Ministry of Food to co-operate with the Ministries of Health and Agriculture, involving a national policy which will help to win the war and have at the end of it a vigorous race ready to take a lead in post-war world reconstruction.

OBITUARIES

Prof. Sigmund Freud, For. Mem. R.S.

BY the death of Sigmund Freud, the world of psychology has lost its best-known figure. Born in 1856 of Jewish parents in Moravia, he decided at an early age to take up the study of medicine. While still in the twenties he went to Paris to study psychiatry under Charcot; and at the age of thirty-one returned to Vienna, where he spent the greater part of his life.

To the scientific world, Freud's name first became known through researches on the nervous system. But while working in France he became strongly impressed with a notion that had already been taking shape in his own mind, the notion, namely, that in the existing state of physiological knowledge nervous disorders are best investigated, not by looking for physical causes, but by studying mental causes, particularly emotional conflict and repression. In his early work as a neurologist he began by applying the methods of hypnosis which he had learnt in Paris. Gradually, however, he abandoned this approach for a more effective technique, to which he gave the name of psycho-analysis. The method, suggested it would seem by the work of Wundt and Galton on free association, threw an unexpected light on symptoms and processes which the patient's answers to the direct questioning of the consultant were apt to leave wholly obscure or even to misinterpret. To-day the term psycho-analysis is applied, not merely to the method, but also to the vast body of doctrine built up with its aid by Freud and his disciples: it might be loosely defined as the empirical study of unconscious mental processes.

The essential framework of Freud's views was laid down in his early writings on hysteria nearly forty years ago. He never hesitated to modify or expand his hypotheses; but in the main his later publications, running to something like two hundred books and articles, consist in suggestive and provocative applications of these leading ideas and principles to various branches of psychology. From the study of major nervous disorders, he proceeded to minor abnormalities that characterize mental life for every one of us—dreams, lapses of memory, slips of the tongue, and the like; and thus showed in concrete detail how the scientific study of the exaggerated reactions of pathological cases may explain the more puzzling or neglected phenomena of normal persons. From this he turned to other fields. Art, poetry, religion, crime, mythology, anthropology—nearly every sphere of life was illuminated by the inquiries he attempted and the principles that he applied.

Freud was, indeed, one of the boldest and most original of thinkers. Nevertheless, the isolated items in his theories were by no means so novel as is popularly supposed. Both in Great Britain and in America a strong reaction against the intellectualistic psychologies of the nineteenth century had already set in: James and Stout had emphasized the need for a more dynamic psychology; McDougall had urged the importance of unconscious motives, particularly in the instinctive and emotional life; Janet had emphasized the importance of dissociation in mental disorder and disease; Havelock Ellis had attempted a scientific study both of dreams and of sex. Freud's own great achievement was perhaps to incorporate what was most fruitful in these ideas in a single, striking, unifying system, and to collect a vast amount of empirical data from a wide variety of sources, all illustrating much the same fundamental mechanisms of the mind.

Though widely read in psychological literature—English and American as well as German and French—Freud never cared to bring his own views into line with academic tradition. This led at first to wide misunderstanding, but was equally a condition of his fresh and revolutionary outlook. In Great Britain, as elsewhere, his bold speculations and even bolder expression of them aroused initial opposition. But a wide experience of nervous disorders during the War of 1914–18 quickly convinced workers like Rivers, Myers and McDougall that there was a most important foundation of truth in the novel doctrines that Freud had advanced. It was perhaps the very antagonism aroused by his frank utterances that in the end gave a wide publicity to the new attitude towards mental

disorder, and brought home to the medical man what the psychologist had long urged—the need for considering not merely the physical but also the mental, emotional, and social condition of his patients.

CYRIL BURT.

Prof. Harvey Cushing, C.B., For. Mem. R.S.

THE death of Prof. Harvey Cushing on October 7 at the age of seventy years removes from the world of medicine its greatest ornament since William Osler. Cushing and Osler had much in common. Each had tireless energy, unbounded enthusiasm, and that great gift of making friends and keeping them. The love of all that was good in literature and of the classics of medicine was as much a characteristic of Cushing as it was of Osler.

Born of a Massachusetts family which had migrated in the early part of the nineteenth century to the Western Reserve, now part of the State of Ohio, Harvey Cushing was the ninth child of a Cleveland doctor whose father and grandfather before him had practised the art of healing. If on his father's side he had inherited a love of medicine, he obtained an almost equal love of literature from his mother, whose forebears had migrated from Connecticut to carry Yale learning to the new country in the west. It was inevitable that he should have graduated in arts from Yale and in medicine from Harvard.

The attraction of Johns Hopkins Hospital was too strong to be resisted by the young graduate in medicine, and there began his life-long friendship with Osler and his apprenticeship in surgery under Halstead. During his early days at Baltimore, he commenced his experimental work, which he continued in Europe under Sherrington, Horsley, Mosso, Kronecker and Kocher. This training was to fit him to be a neuro-surgeon. In the early stages of his surgical career at Johns Hopkins, he had to persevere with his work in the face of a heavy mortality rate in his cases. It was Osler who encouraged him to keep on trying until success came.

Until 1912, when he was appointed to the chair of surgery at Harvard and surgeon-in-chief to the Peter Bent Brigham Hospital, Cushing was laying the foundations on which he built so well in Boston. Physiology and pathology were his favourite studies, but he did not neglect the equally important fields of neurology and ophthalmology. Every new development which could be of use in the study of diseases of the nervous system or employed in the treatment of them was eagerly improved and adapted by him for use in his clinic. With his translation to Boston came the great period of his life; he drew to himself pupils from every civilized country, endowed them with a knowledge of their craft, and engendered in them an affection proof against his ruthless criticism and one which grew with the years. He worked his pupils hard, and after they had set out on their own way, he plied them with questions and tasks which they answered and undertook because it was "the Chief" who had asked them.

Cushing's contributions to surgical knowledge must be his chief claim to fame, but his work on cerebral pathology and physiology is scarcely less outstanding. His earliest monograph, on the pituitary body (1912), was the starting-point from which most of the present-day work on pituitary physiology has sprung. He was a first-class clinician who never neglected or overlooked a sign or symptom which he could not understand. His thoroughness and his amazing powers of observation, coupled with a judgment founded on his own experience, enabled him often to arrive at a diagnosis in cases which had baffled the skill of his colleagues and pupils. He treated the patient as well as the disease, and none better than he knew the value of a word of encouragement or sympathy to a suffering man or woman.

The War of 1914–18 found Cushing in France early in 1915 working with the American ambulance at Neuilly. Later he worked at No. 46 C.C.S. with the B.E.F., and towards the end of the War was transferred to the headquarters of the American Expeditionary Force as its senior consultant in neuro-surgery. He has told the story of those years in his war diary, written mostly when he was weary after a long day's operating and benumbed with the damp cold of a Flanders winter.

On his retirement in 1932, Cushing left Harvard to return to Yale, there, as he so often expressed it, to survey in peace his work on brain tumours and to give to his successors the results of his experience. In his suite of rooms he collected the case records of all his patients. These, together with the after-history of each case, provided him with the material which he used so well in writing his last monograph on the meningiomas. This work was not his only interest at Yale. Since the early days of his friendship with Osler he had collected books. The history of his own craft enthralled him and he collected during the last forty years what must be a unique library of early medicine and surgery. When only a little more than a year ago he came to Great Britain, libraries and booksellers' shops claimed most of his time, for he was engaged on a bibliography of his great hero Vesalius, of whose writings and Vesaliana he possessed an unrivalled collection.

In the world of letters, Cushing gained fame by his biography of Osler. Five years of steady reading and writing went into the making of this book, but during the whole of this time he carried on his work in hospital and laboratory. It was no mean achievement for a busy man. Others have directed attention to his self-effacement in this book. That is a tribute to his own sense of modesty, but it removed from the pages almost every trace of the great friendship of two great men.

WE regret to announce the following deaths:

Mr. M. A. Bailey, director of the National Institute of Agricultural Botany, Cambridge, on October 16.

Prof. A. Gilligan, professor of geology in the University of Sheffield, during 1922–39, aged sixty-five years.

Dr. E. P. Poulton, senior physician to Guy's Hospital and president in 1937 of Section I (Physiology) of the British Association, on October 18, aged fifty-six years.

NATURE

SUPPLEMENT

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SHORT REVIEWS

ANTHROPOLOGY AND ARCHÆOLOGY

African Women

A Study of the Ibo of Nigeria. By Sylvia Leith-Ross. Pp. 367+8 plates. (London: Faber and Faber, Ltd., 1939.) 15*s.* net.

IT is, of course, no more possible to generalize about the African woman than it is about the women of Europe and still less Asiatic women. Notwithstanding the title of her book, Mrs. Leith-Ross makes no such elementary mistake. She gives her readers the results of a careful and detailed investigation of the position of women among the Ibo people of Nigeria; and even here, she is careful to discriminate. The specific problem with which she was concerned was the reaction of the Ibo woman to the changes which are taking place around her under European administration and owing to the contacts with white civilization. Mrs. Leith-Ross, whose acquaintance with the African is of long standing, directed her observations to female life and character in four different types of community: the isolated bush community, where traditional patterns have suffered little modification, or at least so it would appear; a semi-sophisticated rural community, in which certain ideas and movements are beginning to stir the surface, more especially in the women's societies and organizations, such as on a previous occasion gave rise to serious trouble; a town of some considerable size; and finally the commercial and administrative centre, in which society, both European and more especially African, is cosmopolitan or mixed.

The Ibo woman, like women among many other African peoples, is by no means the conventional down-trodden creature of popular conception. She has a sturdy independence, and in some respects is 'more of a man' than her husband. Nor is she cut to a single pattern. The contrast shown here between the women of the bush and the semi-sophisticated village is instructive, and goes deeper than any difference due to degree of white contact. Apart from such individual differences, however, the progression in change of behaviour and character as the author passes from one type of community to another is very clearly marked.

Manuel de préhistoire générale:

Europe, Asie, Afrique, Amérique. Par Prof. Raymond Furon. (Bibliothèque scientifique.) Pp. 398+8 plates. (Paris: Payot et Cie., 1939.) 50 francs.

DR. FORON'S manual covers a wider field than its title immediately suggests. It deals—as the author recognizes—with what is now termed proto-history as well as pre-history, telling the story of man from his earliest beginnings down to the iron age and the spread of the Celtic-speaking peoples.

As the aim of the author is to provide an introduction to archæological studies, rather than an exhaustive treatise, it would, perhaps, be less than fair to criticize a lack of balance in treatment. Nevertheless, it must be pointed out that while one half of the book is devoted to the descent of man and stone age culture down to the end of the palæolithic, and seventy pages are given to mesolithic and neolithic, one hundred pages have to suffice for the bronze and iron ages; while Australia and America are dealt with apart in twenty pages. As the whole of the Old World is covered by geographical regions throughout, it will be realized that in the later periods Mesopotamia, Egypt, Crete, and the various geographical regions of Europe come in for extremely short measure indeed. Nevertheless, so far as it goes, the matter is as informative as it can be in so brief a space, while the ampler treatment given in the earlier section relating to the physical development of early man and his predecessors, and the account of early stone age cultures, as known in 1937, the date of the latest reference, will be found most helpful as a general introduction. This applies in particular to the lucid account of the bearing of recent geological and palæontological research on the chronological problem in quaternary times.

Tools and the Man

By W. B. Wright. Pp. xvi+236+9 plates. (London: G. Bell and Sons, Ltd., 1939.) 12*s.* 6*d.* net.

IN one sense the late Dr. Wright's presentation and survey of present-day knowledge of the data bearing on early man and the development of his material culture in the early stone age supersede all previous manuals of the kind. It is the first of such handbooks

available for the general reader and the student to review critically the earliest material from East Anglia which, it is claimed, shows evidence of human handiwork, and to give an account of the investigations of the Abbé Breuil on the gravels of the Somme and their bearing on and consequences in determining the dating of palæolithic industries, which, it would seem, must now be subjected to considerable revision. A summary account of the latter research by the Abbé Breuil himself for the benefit of British archæologists appears in the current issue of the *Proceedings of the Prehistoric Society*. Further, Dr. Wright, while pointing out that the familiar classification of palæolithic implements, based on the material from France, is too deeply rooted in archæological studies to be ignored in a general survey, adopts and expounds the core-flake classification of implements, entering fully into its technological, classificatory and ethnical implications, as affecting the world-wide study of stone age cultures.

Dr. Wright's critical examination of the evidence and of the development of hitherto accepted theory, consequent upon recent archæological discovery and discussion, gives this manual an authoritative position, and makes it, at present, unique in the English literature.

Studies on the Ice Age in India and Associated Human Cultures

By H. de Terra and T. T. Paterson. (Publication No. 493.) Pp. xi+354+56 plates. (Washington, D.C.: Carnegie Institution, 1939.)

AS Dr. de Terra and Mr. Paterson themselves have already summarized the main results of their investigations for the benefit of the readers of NATURE, it would be a work of supererogation to deal here with their report in its final form in detail. It will perhaps suffice to indicate its scope and distribution of topics. The report is in five parts, of which the first deals with the ice age in south-western Kashmir; the second covers conditions in north-west and peninsular India, so far as indicated by investigations in two main regions, the Soan basin and the Indus river; the third section deals with the Nerbada valley Pleistocene; Part iv is concerned with the stratigraphy and typology of Madras; and the fifth and final section is devoted to the late stone age sites of Sukkur and Rohri on the lower Indus, a proto-neolithic civilization, which it is held may suggest an indigenous evolution and not a foreign origin for Mohenjo-daro and the Indus civilization.

The Mind of Primitive Man

By Franz Boas. Revised edition. Pp. x+285. (New York: The Macmillan Company, 1938.) 12*s.* 6*d.* net.

IT is a remarkable tribute to the enduring qualities of the work of the veteran American anthropologist that a new edition of this book should be demanded so many years after its original publication, and when so many developments have supervened in anthropological thought in the interval. The book on its first appearance attained a position of considerable authority not only on account of the originality of its views on the calibre of the mind of primitive man, but also for its statement of the results of the author's observations on changes in the physical characters of immigrants and their descendants after entry into the United States. In the new edition, which has been thoroughly revised, Prof. Boas denounces with unimpaired vigour, in a review of anthropological theories of race, the perversion of racial theory in the interests of political prejudice and propaganda.

(1) Masques Dogons

Par M. Griaule. (Université de Paris: Travaux et Mémoires de l'Institut d'Ethnologie, Tome 33.) Pp. x+896+32 plates. (Paris: Institut d'Ethnologie, 1938.) 275 francs.

(2) Jeux Dogons

Par M. Griaule. (Université de Paris: Travaux et Mémoires de l'Institut d'Ethnologie, Tome 32.) Pp. viii+290+12 plates. (Paris: Institut d'Ethnologie, 1938.) 87.50 francs.

(1) THE masked dances which are the ritual manifestation of the ancestor cult of the Dogon of the French Sudan have been made the subject of an elaborate study by M. Griaule. This study is based upon material collected in the course of three expeditions between 1931 and 1937. Although the Dogon all recognize and worship a supreme creating deity, the masks, and the dances in which they figure, and the ancestral cult with which they are associated, take a much more prominent place in their daily life and thought. Of the ancestral spirits, some are regarded as immortal, while others, who belong to the time after death appeared on the earth, are held to be mortal. From the relations to the immortal ancestors, who have returned to exercise a protective function over their descendants, has originated a totemic cult; while the cult of the masks and the dances in which they are used is directed to those of the ancestors who have suffered death.

M. Griaule has made a comprehensive study of an extremely complicated system of religious beliefs, in which *nyama*, a belief akin to the *mana* of Pacific peoples, plays an important part. Students of the history of religions will find here much of the greatest interest.

(2) M. Griaule's record of Dogon children's games, as played in the Bandiagara-Sanga-Kassa district, a region 80 km. long by 10 km. broad, is no less detailed than his study of Dogon masks and dances. It includes a large number of games of every type and variety, some of them belonging to groups which have a very wide geographical distribution. Among the games appearing here which have a special interest are those of a proverbial character, involving a guessing competition, these being especially expressive of Dogon mentality. The author notes a large number of string figures, which have been both carefully recorded and fully illustrated. M. Griaule's monograph is a valuable and very instructive contribution to the literature of a fascinating study.

Biology

Intermediate Botany

By L. J. F. Brimble. Second edition. Pp. viii+562. (London: Macmillan and Co., Ltd., 1939.) 8*s*. 6*d*.

THAT in a comparatively short time a second edition of "Intermediate Botany" should be called for is clear evidence that it has been appreciated by teachers and students and has been found as helpful to them as we expected when it first appeared.

While the subject-matter has not been materially altered, the text has been revised and brought up to date in certain directions. Thus in connexion with the discussion of the acceleration of germination a paragraph has been added pointing out the agricultural and economic importance of the recent researches of the Russian investigator Lysenko. By subjecting the germinating grain of winter wheat to low temperature he was able to get it to reach maturity even when sown in spring. This yarovization of grain, as it has been called, is one of the most important botanical discoveries of recent years and its implications will probably have far-reaching results.

In describing the interesting experiments dealing with growth-promoting substances or hormones Mr. Brimble has extended his account by directing attention to the horticultural importance of recent work on this subject, which aims at accelerating the formation of roots on cuttings by treating the latter with synthetic auxins and hetero-auxin. A figure showing the effect of these substances on the formation of roots on cuttings of Buddleia (not Buddleja) is given.

This and other new figures which have been added increase the attractiveness of the book and will be found helpful by its readers. In some cases also better illustrations take the place of some appearing in the first edition. Thus the photograph of the roadway through the base of the Big Tree (Sequoia) and the figure of the Venus fly trap are distinct improvements.

Speaking generally, the value of the book has been enhanced by the careful revision and by the additions made to the text and the illustrations. The second edition will receive as cordial a reception as the first has done.

Practical Botany

A First Year Course for University and Intermediate Science Students. By Dr. S. Williams and Dr. G. Bond. Pp. 96. (London: Edward Arnold and Co., 1939.) 5*s*. 6*d*. net.

THIS book follows the method now very popular in the United States for practical laboratory guides whereby the pages are loose; this, as the authors state, allows "for the interleaving of the book with drawing paper and thus the students' drawings should make the completed book a reasonably adequate factual text-book". The authors omit, however, to point out another important advantage of the method they have adopted, that is, the opportunity thus afforded of changing the order of things in conformity with varying laboratory routine.

The authors have wisely kept the number of illustrations down to the absolute minimum—eight figures in all.

The standard of the course is indicated in the title; but the course is very full, thus allowing a certain amount of choice, and accuracy and personal observation and experimentation are obviously the keynotes throughout.

Unlike many science text-books of this standard, this contribution will certainly fill a serious gap, for, so far as we know, there is no satisfactory practical guide to botany of the standard of post-School Certificate and post-Matriculation. It can be recommended to university departments of botany for the use of first-year students, and to schools where botany is taken in the Higher School Certificate examinations.

Vitamine und Hormone:

und ihre technische Darstellung. Von Dr. Hellmut Bredereck und Dr. Robert Mittag. Teil 1: Ergebnisse der Vitamin- und Hormonforschung. (Chemie und Technik der Gegenwart, herausgegeben von Dr. H. Carlsohn, Band 15.) Zweite neubearbeitete Auflage. Pp. xii+138. 7 gold marks. (Leipzig: S. Hirzel, 1938.)

Vitamine und Hormone und ihre technische Darstellung

Teil 2: Darstellung von Vitaminpräparaten. Von Dr. Franz Seitz. (Chemie und Technik der Gegenwart, herausgegeben von Prof. Dr. H. Carlsohn, Band 20.) Pp. xi+205. (Leipzig: S. Hirzel, 1939.) 10 gold marks.

THESE are two indispensable volumes for all who have to follow closely the progress of work in the fields of vitamin and hormone chemistry. They are skilfully prepared encyclopædias giving an immense amount of information in an unusually small compass. Particularly valuable is Dr. Franz Seitz's volume dealing with the technical aspects of the subject. A bibliography of technical and patent literature is given which is alone worth the cost. Two admirable works in a well-planned and well-executed series of monographs. J. C. D.

The Insect Legion

By Dr. Malcolm Burr. Pp. xiv+321+16 plates. (London: James Nisbet and Co., Ltd., 1939.) 12*s*. 6*d*. net.

MANY popular books on insect life have appeared in the English language but the present volume, from the pen of a mining engineer, is undoubtedly the best of them. Since Dr. Burr is also himself an original investigator of insect life, besides being a traveller and a linguist, he is able to approach his subject from the widest point of view. The result of his efforts is a book of real charm: it is moreover reliable and accurate as to its facts and details, and its author has widely combed the revelant literature for much of his information. We can unreservedly recommend it as an admirable introduction to its subject and one that will appeal to adults and juveniles alike.

Chemistry

(1) Dyeing with Coal-Tar Dyestuffs

The Principles Involved and the Methods Employed. By C. M. Whittaker and C. C. Wilcock. Third edition. Pp. vii+326. (London: Baillière, Tindall and Cox, 1939.) 12*s*. 6*d*.

(2) Hair-Dyes and Hair-Dyeing Chemistry and Technique

By H. Stanley Redgrove and the late Gilbert A. Foan. A new edition completely revised by H. Stanley Redgrove and J. Bari-Woollss. Pp. xiv+214+8 plates. (London: William Heinemann (Medical Books), Ltd., 1939.) 10*s*. 6*d*. net.

THESE two books on dyes and dyeing are in such striking contrast to one another as to justify their inclusion in the same notice.

(1) The first is a succinct account of the general processes of dyeing with the so-called coal tar dyestuffs—a term better indeed than 'aniline' dyestuffs, but nevertheless redundant since there are nowadays no dyestuffs of importance that are not derived from coal tar intermediates.

The book is divided into fifteen sections each dealing with some group of dyestuffs and giving information of value to the users of dyes. Section xi on the dyeing of rayons, and Section xii on the dyeing of synthetic fibres with an affinity for wool dyestuffs, are particularly well written. The book will be of interest to all concerned with the subject of dyeing.

(2) The second is a most amazing book which will be found of great interest to a wide circle of readers. To the uninitiated it is a revelation by which one can recognize a host of friends. The dreadful devices to which the female of the species subjects herself in order, in her opinion, to make herself pleasing to the male, are set out here in all their terrible entirety. The illustrations alone give one a glimpse into the beauty parlour which must make every male shudder with horror. But so be it! Women have done it since the beginning and will do it to the end. J. F. T.

Inorganic Chemistry

By F. A. Philbrick. Pp. viii+396. (London: G. Bell and Sons, Ltd., 1939.) 6*s*.

THIS book provides a course in inorganic chemistry up to the standard of the Higher Certificate, Inter B.Sc. and First M.B. examinations. The author has wisely devoted the introductory chapters to a brief sketch of chemical principles such as the atomic and molecular theories, electrolytic dissociation and electronic theory of valency, which should prove of value to students who have little knowledge of physical chemistry.

The elements are classified and discussed in the order in which they occur in the Mendeléeff table; for example, copper and silver are described in the same chapter as the alkali metals, and manganese, a steel-forming metal, finds its way into the end of the chapter on the halogens. This old-fashioned and clumsy arrangement is not in keeping with the modern and up-to-date factual matter which is given in the text, and is partly responsible for the too brief inter-comparison of the elements. The omission, however, of detailed descriptions of unimportant compounds is a welcome feature, as is also the emphasis which has been laid on the practical applications of inorganic chemistry. The numerous photographic illustrations, collected from many different countries, are an additional attraction. Questions are given at the ends of the chapters, and a selection of revision papers is provided at the end of the book, together with answers to the numerical problems. The omission of logarithm tables is to be regretted, and the index is certainly too brief for a work of this calibre.

Apart from these criticisms, the book is a welcome addition to existing text-books of intermediate standard, and can be recommended to both teachers and students of chemistry. A. C. C.

Intermediate Chemical Calculations

By Prof. J. R. Partington and Kathleen Stratton. Pp. x+240. (London: Macmillan and Co., Ltd., 1939.) 6*s*. 6*d*.

IN accordance with its title, this book provides a complete course of numerical examples, intermediate in standard between the General School Certificate and B.Sc. examinations. A concise but clear account of the fundamental principles underlying the calculations is given at the beginning of each chapter or section, and then suitable examples are worked out in detail for the guidance of the student before he tackles the numerous problems. The latter are chosen in part from former Higher Certificate, M.B. and University Scholarship examinations, and answers are provided at the end of the book.

The subject-matter throughout is accurate and up to date; for example, problems are not set which imply that the extent of ionization of a strong electrolyte can be obtained from molecular weights in solution or from conductivities. It is gratifying, too, to find a clear distinction between the density and relative density of a gas. In the opinion of the reviewer, a copy of this book should be possessed by all teachers and university students, and should be available for the 'Science Sixths' of all schools.

A. C. C.

Wood Pulp

By Dr. Julius Grant. Pp. xi+209. (Leiden: Chronica Botanica Co.; London: Wm. Dawson and Sons, Ltd., 1938.) 7 guilders; 15*s*.

THIS is one of the "New Series of Plant Science Books" edited by Dr. Frans Verdorn and printed and published in Holland. It is a comprehensive treatise and contains everything worth knowing on the subject of wood pulp. The multitude of uses to which this material is now put makes it at the present day one of the most valuable natural products that exist. Although the supply is enormous, especially in our jungles and forests, the cost of collection must be almost prohibitive except in places that are supplied with water-transport or other such facilities. Those who have been so fortunate as to visit Shawinigan will realize the speed with which forests in

favourable positions are disappearing. The work of afforestation lingers, alas! far behind.

The book contains a very readable account of the sulphite process, with a section devoted to the history of this great discovery. The other chief processes of purification are also described, and those who are interested will find all the information they need. The book is well set up and is likely to be of great service to those concerned. J. F. T.

ENGINEERING

Electro-Acoustics

By Prof. Dr. Erwin Meyer. Pp. xi+117+12 plates. (London: G. Bell and Sons, Ltd., 1939.) 10*s*. net.

BOTH the orthodox student of electricity and the orthodox student of acoustics are at a loss when confronted with the intricate and subtle marriage between the two classical subjects which has taken place in recent years in response to public demand.

Dr. E. Meyer, from the erstwhile Heinrich Hertz Institute, now known as the Institut für Schwingungsforschung, came, at the invitation of the University of London, and gave a series of five lectures at the Institution of Electrical Engineers on his view of the present position of electro-acoustics; the present volume records his material, showing that he discharged his task well. He speaks of what he has first-hand knowledge, and his almost entirely Teutonic set of references shows that the Americans are not undisputedly in the lead in this field. The chapters, corresponding to the lectures, deal with physical and physiological foundations, which include evidence that the strike note of a bell does not exist, and some new applications of supersonic waves; electro-acoustical measurements, describing an acoustic grating analyser, and the high-speed level-indicator and the spectral analyser in use at the National Physical Laboratory; microphones and loud-speakers, with reference to response-curves and transient times, and the logarithmic modulation meter; sound recording and electrical music, with some explanation of magnetic recording and note synthesis; and architectural acoustics, in which methods and results of reverberation measurements and the absorption of acoustic materials are considered, with an engaging reference to his scheme of measuring reverberation periods with audience, by using isolated chords from a full orchestra and suitable filters. Clearly Dr. Meyer could deal with few details, but the ground covered is impressive and gives a plan for those who are engaged in working in a small corner of it. L. E. C. H.

Handbook of Technical Instruction for Wireless Telegraphists

By H. M. Dowsett. Sixth edition. Pp. xx+624. (London: Iliffe and Sons, Ltd., 1939.) 21*s*. net.

THE present text is obviously of little use to the scientifically minded, but it serves two essential purposes very well. It shows clearly the type of apparatus which the practical wireless man has to deal with, and its mode of operation, information which is of the greatest importance to researchers and developers of new types of equipment. At the same time, it forms an excellent record of the state of the art of radio communication at the moment, omitting only high-powered point-to-point working. The aim is to assist operators to get their certificates, and to acquaint them with every conceivable type of apparatus they are likely to come across, for communication, navigation, and for emergency. The circuit diagrams are particularly clear, and much information is tabulated for easy reference.

L. E. C. H.

MATHEMATICS

The Kelley Statistical Tables

By Prof. Truman Lee Kelley. Pp. vi+136. (New York: The Macmillan Co., 1938.) 20*s*. net.

THE normal or Gaussian distribution occupies a central position in statistical theory and practice, and is therefore naturally the most completely tabled distribution function. Prof. Kelley now takes a further step, and provides a table of the abscissæ and ordinates of the distribution to 8 decimal places against the cumulative probability as argument, proceeding by intervals of 0·0001. The table is clearly printed and of a convenient size, and the minimum of interpolation is required to provide results to the accuracy ever likely to be demanded in statistical problems.

Prof. Kelley takes the opportunity of including in the volume other useful tables. For values of p proceeding by intervals of 0·0001 from zero to unity he gives to 8 decimal places values of $\sqrt{pq}$, $\sqrt{1-p^2}$, and $\sqrt{1-q^2}$, where q is $(1-p)$. Statisticians will recognize these quantities as being of frequent occurrence in relation to the binomial distribution and the theory of correlation. Another table gives the coefficients of the cubic Lagrangian interpolation formula to 10 decimal places for an argument proceeding by intervals of 0·001. With modern calculating machines these coefficients are often more convenient than the Everett coefficients used in connexion with a difference formula.

Statisticians will appreciate the labours which have gone towards this well-produced volume.

The Theory and Use of the Complex Variable

An Introduction. By S. L. Green. Pp. viii+136. (London: Sir Isaac Pitman and Sons, Ltd., 1939.) 10*s*. 6*d*. net.

THE theory of functions of a complex variable is usually presented in exhaustive treatises, demanding high mathematical attainments from their readers. Yet engineers and others who have neither the time nor the specialized training in pure mathematics to master such treatises find that they require some of the leading ideas of the subject. Mr. Green provides an introductory account of the complex variable and of conformal representation in a very simple and compact form, demanding from the reader little more than elementary calculus and co-ordinate geometry, with some indication of applications to problems of mathematical physics, aeronautics and electrical engineering.

Miscellany

Borneo Jungle

An Account of the Oxford Expedition to Sarawak. By John Ford, C. M. Hartley, Tom Harrisson, Patrick M. Synge, Edward Shackleton. Edited by Tom Harrisson. Pp. x+254+32 plates. (London: Lindsay Drummond, Ltd., 1938.) 15*s*. net.

"BORNEO JUNGLE", which describes an expedition of the Oxford University Exploration Club to Sarawak in 1932–33, stands out in the class of travel books in virtue of its method of composition. Instead of one or two authors, it has five, each contributing a chapter. The result is both entertaining and instructive.

The organizer of the expedition, Mr. Harrisson, who notwithstanding his not very advanced years—the average age of the members of the expedition was then twenty years—has already won a reputation as a writer of original views, describes the organization and outlines the work of the expedition as a whole. The chapters by his colleagues all contribute some interesting observations of the daily life and character of the jungle folk of Sarawak; but without being invidious, special mention may be made of Mr. Patrick M. Synge's account of collecting epiphytes in the forest at different altitudes and his discussion of the relation, if any, of the æsthetic qualities of the flora to the art motifs of the people.

Members of the expedition and others working on the material collected have already produced twenty-nine scientific papers, while further studies are in course of preparation. The standing of the expedition, in a scientific sense, is therefore assured. It is necessary to say this, as Mr. Harrisson vigorously attacks scientific exploring expeditions in general, especially if their aim is the collection of specimens, and expeditions of the type of those organized by the Oxford Exploring Club more particularly as failing in their educational aim. This raises too large a question for discussion in a brief notice; but in part the author supplies an answer in recognizing the constraining influence of finance.

The Climate of Madeira

With a Comparative Study. By Vice-Admiral Hugo C. de Lacerda Castelo Branco. Translated from the French by Dr. Alberto Figueira Jardim. Pp. 118+9 plates. (Madeira: Delegação do Turismo da Madeira, 1938.)

THE little book by Vice-Admiral H. C. de Lacerda Castelo Branco on the climate of Madeira, or more precisely Funchal, an English translation of which is under notice, was written with the definite object of comparing the merits of the island with those of other favoured resorts, and it certainly contains a considerable amount of propaganda. Nevertheless the author, who was many years ago director of the meteorological observatory at Lourenço Marques, has been at pains to embody in it much scientific data and to direct attention to the need for further investigations. Some thirty earlier publications, dating from 1811 onwards, are commented on briefly as a preface to his own 'sketch' based upon observations at Funchal since 1923 and official averages for 1916–35. Both sets of figures show the well-known characteristics of mild winters and moderately warm summers. From a table on p. 47, relating to the years 1923–32, the absolute maximum temperature in July (82·6° F.) appears lower than that in any of the other months from April to October. It may be noted in passing that this is doubtless due to the shortness of the period, as considerably higher values have been recorded in July.

In the comparisons with other climates the author seems over-lavish in his praise of the relative value of that of Funchal, but he is careful to state that conditions in other parts of the island may be less good. Further research is advocated not only as regards the climate but also into certain medical and other matters affecting the general conditions of life there which are discussed in the concluding chapters.

L. D. S.

Mineral Tables

For the Determination of Minerals by their Physical Properties. By Arthur S. Eakle. Third edition, revised by Prof. Adolf Pabst. Pp. v+73. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 7*s*. 6*d*. net.

PROF. A. S. EAKLE, of the University of California, published tables in 1904 by which the common minerals could be 'run down' by using in a systematic manner the properties of streak and colour, and by the observation of other characters such as hardness, crystal symmetry, cleavage and fracture, the habit or structure of the mineral, the specific gravity, and the chemical composition. Dr. A. Pabst has revised Eakle's tables, making such additions and changes as were necessary to bring them up to date. About 200 minerals are included. For the application of the tables the only apparatus required is a streak-testing plate of unglazed porcelain, a pocket knife and set of minerals for the scale of hardness, a magnet and a pocket lens. Admittedly tests with this simple equipment do not suffice to identify definitely every mineral, and recourse must frequently be had to determination of specific gravities and to optical and chemical tests, but the application of the physical tests in a systematic way is good training for the student who will need to identify minerals in the field.

The League of Nations and the Rule of Law, 1918–1935

By Sir Alfred Zimmern. Second edition, revised. Pp. xiii+542. (London: Macmillan and Co., Ltd., 1939.) 12*s*. 6*d*. net.

THE second edition of this book differs but little from the first edition of 1935. It has not been extended beyond the limits then planned and although it has been thoroughly revised and the references to the literature brought up to date, new matter has been incorporated chiefly in the chapters on the drafting of the Covenant, and the history of the League of Nations, the latter merely bringing the account of the Abyssinian dispute up to 1936. None the less the book remains an invaluable guide to the problems involved in the re-establishment of the rule of law between nations.

PHYSICS

Higher School Certificate Practical Physics

By E. Armitage. Pp. xx+239. (London: John Murray, 1939.) 6s.

THE author's aim in this book is two-fold: first, to enable a form of post-School Certificate pupils to commence different experiments without wasting time at the beginning of a practical period, and secondly to cover the experiments that are likely to be met in the various practical examinations for Higher Certificate, Inter-B.Sc., and First M.B. examinations. The book includes more than a hundred experiments in all the necessary branches, and so a very useful selection can be made.

One outstanding feature of the book is the attempt made by the author to have the complete account of each experiment in front of the student while working, thus obviating the necessity of having to turn pages over. This undoubtedly has its advantages, but it rather detracts from the appearance of the book, inasmuch as some pages are of necessity left half blank.

There are many diagrams in illustration of the apparatus used, but these might in many cases have been larger and bolder.

The treatment of the experiments is very sound, and a pleasing feature is the attention paid to the expression of results graphically—a point which deserves due emphasis—though the article on graphs in the early part of the book seems scarcely necessary in a book of Higher Certificate standard. Indeed there are several instances of superfluous instructions and so on, since it must be assumed that most of the students will have already gone through a course in the handling of apparatus.

From a utilitarian point of view, the book is undoubtedly a distinctly helpful one for those students who wish to become accustomed to the type of experiment they are likely to encounter in their practical examinations; it will, however, scarcely satisfy the needs of those who believe in learning a lot of the theory of the subject through the practical approach, a method not to be despised even with Higher Certificate students.

A useful addition to the book would be tables of physical constants, also a set of mathematical tables.

Practical Physics

By W. F. F. Shearcroft and J. H. Avery. Pp. xvi+268. (London: William Heinemann, Ltd., 1939.) 8s. 6d.

THIS book claims to provide for any course immediately following School Certificate or Matriculation, and to cover Higher School Certificate requirements up to distinction standard. There is a large selection of experiments—151 in all—though an appreciable number of these experiments would normally be dealt with in a School Certificate course.

A good deal of time has evidently been spent in planning the treatment of the experiments, and one good feature which will undoubtedly appeal to students is the numbered instructions describing precisely how the experiment should be carried out.

Seventeen pages at the beginning of the book are devoted to introductory matter and experimental instructions, but one feels that quite a lot of this could be omitted from a book of this standard. In the electricity section, about nine pages are devoted to an explanation and diagrams of elementary apparatus, but surely this should scarcely be necessary. In view of the importance attached to diagrams by examining bodies, it would have been a better example to students to have used the space so taken up in the book to make larger and bolder diagrams of the apparatus, etc., used in the experiments, and to include diagrams where they are at present missing.

Due attention is very rightly paid to graphical work, and it is pleasing to see that in the experiments on light the 'optical bench' treatment, using actual beams of light, at least holds its own with the 'pin' or 'no-parallax' method.

A useful set of exercises is included at the end of the book, also two sets of tables, but one feels that this section could with advantage have been larger; mathematical tables in particular would be very useful to students. Finally, certain illustrations arranged vertically along the edge of the page are irritating, while the plate facing p. 204 would seem to be totally unnecessary.

Introductory Quantum Mechanics

By Prof. Vladimir Rojansky. Pp. x+544. (New York: Prentice-Hall, Inc.; London, Glasgow and Bombay: Blackie and Son, Ltd., 1939.) 5.50 dollars; 22s. 6d. net.

THE main difficulty which a text-book on quantum mechanics has to overcome, namely, to present the maximum of physical results with the minimum of mathematical formalism, is very well overcome in this book, by clever navigation between the Scylla of rigour and the Charybdis of obscurity.

The operator calculus, the theory of eigenfunctions and eigenvalues, the matrix method are well explained and illustrated by significant examples. Each chapter is provided with a collection of exercises which will be very useful for students as well as for teachers. The development of the physical notions does not follow the historical order. Schrödinger's method is introduced first and its fundamental assumptions are stated somewhat axiomatically. Heisenberg's and Dirac's considerations are described in later chapters.

The advantage of this procedure is its brevity, and the possibility of a logically coherent system, connecting all different aspects of the theory. This purpose has been achieved; the presentation of the fundamental statistical conceptions especially is very satisfactory. But a student who would learn quantum mechanics from this book only will get no impression of the intellectual struggle which led to the final theory. This unhistoric attitude is observable

even in such details as the quotation of literature; the names of American authors who have added refinement to an existing theory are included, while those of the originators are omitted. Apart from these minor objections, the book can be warmly recommended.

Elementary Survey of Physics

A Non-Mathematical Presentation, with a Special Supplement for Pre-Medical Students. By Prof. Arthur E. Haas, with the collaboration of Prof. Ira M. Freeman. Pp. x+204. (London: Constable and Co., Ltd., 1939.) 7*s*. 6*d*. net.

THERE is a tendency to-day to impart a general acquaintance with physical science to students outside this field; even those in the college of liberal arts are now taught the elements of physical science as part of their general culture. A serious difficulty arises from the antipathy on the part of most students, including pre-medical students, to the application of mathematical methods. Prof. Haas has presented a survey of physics without introducing mathematics except of the most elementary nature. In spite of the absence of mathematics, the field covered is comprehensive, and the explanations are so lucid that no one need be deterred by the fear of failure to understand the physical picture of Nature delineated by the author.

There are two appendixes. The first deals with the more important applications of physics to medicine, especially in such fields as light therapy, electrotherapy, radium therapy, etc. The second appendix supplies a number of elementary formulæ which can be applied by anyone with only a very meagre mathematical equipment. It may be safely predicted that the work will commend itself to a large number of students, and the general public too will find it most readable. M. D.

Psychology

Introduction to Psychology

By Edwin Garriques Boring, Herbert Sidney Langfeld, Harry Porter Weld and Collaborators. Pp. xxii+652. (London: Chapman and Hall, Ltd.; New York: John Wiley and Sons, Ltd., 1939.) 15*s*. net.

IT has been generally felt for many years that the writing of an up-to-date text-book on psychology required specialized knowledge of so many branches of the subject that it was beyond the power of any one man. Two or three years ago, three distinguished American psychologists, with the help of a number of collaborators, produced "Psychology: a Factual Textbook", which was very generally welcomed as a satisfactory text-book for courses in Great Britain also. As a result of the numerous suggestions they received from users of the book, they have now produced a new edition so radically different that they have given it a new title.

Their earlier edition followed the conventional order of treatment in which sensation and perception came first and led up to problems of personality and social psychology at the end. They have now made the bold innovation of reversing this order. They have felt that much of the treatment of sensation and perception, about which relatively much is known, can with advantage be left to specialist courses. Also they have thought it an advantage to start with the functioning of the organism in the social environment, about which the student has more previous knowledge than he has of sensory functions. This is no doubt true, but this method of approach sacrifices the advantage of beginning with a part of the subject on which there is much exact scientific knowledge.

The previous edition proved itself a satisfactory text-book. It was up to date, accurate and eclectic. In its new form, with additional matter and an increased number of collaborators, it appears to have sacrificed none of these merits. It should prove to be as satisfactory as its predecessor. Whether the new order of presentation is the better can only be told by trial. R. H. THOULESS.

Children with Delayed or Defective Speech

Motor-Kinesthetic Factors in their Training. By Sara M. Stinchfield and Edna Hill Young. Pp. xvi+174. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1938.) 14*s*. net.

THIS most useful book describes the theory and practice of the Hill Young School of Speech in Los Angeles. It is divided into two parts, the first by Dr. Stinchfield, discussing the problem to be solved in dealing with children with delayed or defective speech, and the second by Mrs. Young, dealing with the practical side.

It is estimated that there are four million children in the United States handicapped in the use of speech.

The treatment consists briefly in training muscular action for whole words. There is a liberal supply of photographs showing how the child is taught to use his muscles in the enunciation of the various words used.

Man against Himself

By Karl A. Menninger. Pp. xii+485. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1938.) 15*s*. net.

DR. K. A. MENNINGER, who some years ago produced an excellent book, "The Human Mind", has given us a very interesting book on some of the wider implications of suicide in "Man against Himself".

The book is largely based on psycho-analytical principles. After a brief consideration of suicide as commonly understood, the author deals with what he calls chronic suicide, which includes asceticism, neurotic invalidism and alcoholic addiction, and then with focal suicide, which includes mutilations, purposive accidents, impotence and frigidity and polysurgery.

The treatment consists in self-reconstruction, dealing with the aggressive, self-punitive and erotic motivations.

NEWS AND VIEWS

Ministry of Information

Question time in the House of Commons during the past few days has produced a crop of inquiries about the Ministry of Information. As is well known, the staff of the Ministry has suffered drastic reduction as the result of the criticism levelled against it. On October 18, Sir John Graham Kerr asked the Parliamentary Secretary to the Ministry of Information, "in view of the important part played in modern warfare by science and in view of the importance of accuracy in public information regarding such matters, how many of the 190 members of the staff of the Ministry, of which particulars have recently made public, are university graduates in science?" Sir Edward Grigg said in reply that the "information is not available and could only be obtained at an expense of time of which I should not feel justified in giving to the inquiry". He added that "scientific advice can be obtained whenever necessary from a large range of experts in Government service and outside it, and that it is therefore unnecessary to add on that account to the establishment costs of the Ministry". While it will not be denied that such advice is available, it is difficult to see how the Ministry, without scientific guidance from within, can hope to utilize to the full the scientific knowledge of the country.

Camouflage (Advisory Committee)

On August 2 last, an advisory committee on camouflage by the use of paint, was appointed by the Government, which agreed that it should include a scientific member. Sir John Graham Kerr asked the Home Secretary on October 19 how many meetings this committee had held since its formation. Sir John Anderson, in reply, stated that the first meeting of the committee was held on October 18. In reply to a supplementary question, Sir John Anderson said that "the committee has been so constituted as to bring to bear on this important question of camouflage the opinions of many people who hold differing views on the theoretical and practical aspects of the question. The reference to the committee is very wide, and I have no doubt that the committee will be in a position to address itself to the question". No explanation was offered of the lengthy delay between the setting up of this committee and its first meeting.

Advisory Research Council of the Chemical Society

The Council of the Chemical Society has formed an Advisory Research Council, under the chairmanship of Sir Robert Robinson, the main function of which will be, when approached, to bring to the notice of fellows and others engaged in chemical research, subjects for investigation likely to be of potential value to the nation at the present time. In the first instance such advice will be made available to unremunerated research workers (that is, unremunerated as research workers for some specific purpose) in universities, colleges and other research institutions, and to research students in receipt of grants not definitely related to any particular topic or in regard to which the topic can be changed. It is hoped to effect liaison with Government departments and industrial organizations so that the Advisory Research Council may be cognizant of pressing problems needing investigation and thus be able to suggest lines of research of national value. It will not be a function of the Council to exercise control over any research that may be undertaken. The field to be covered will embrace every branch of pure chemistry and include biochemistry and metallurgy. Chemists and various organizations (industrial and otherwise) will be invited to send in suggestions for research, and a list of topics for research considered of national importance will be drawn up and will normally be available to those wishing to make use of it for the purpose of initiating an investigation. Inquiries and suggestions may be sent to the General Secretary, Chemical Society, Burlington House, Piccadilly, London, W.1.

New Anthropological Periodical in India

India is so poorly supplied with anthropological literature that the appearance of a new periodical to be devoted entirely to the scientific study of anthropology must be regarded as something of an event. The work of the Indian Anthropological Institute, to which reference is made elsewhere in this issue of Nature (see p. 721), has been hampered seriously ever since its inception in 1936 through lack of an official organ for recording the deliberations and discussions of its members. Financial conditions proved an insuperable obstacle until the University of Calcutta, thanks to the good offices of the Vice-Chancellor, Mr. Syamaprasad Mookerjee, generously came to its assistance with an offer to assume responsibility for printing the *Journal* of the Institute free of charge. The first issue, which has appeared recently, includes communications received from members up to the close of 1938, among them the presidential address by Dr. J. H. Hutton, the first president, in which he puts forward the suggestion that the Institute should formulate a five years' plan of research, to be entrusted to sub-committees, and Colonel Gordon offers some pregnant, as well as pungently critical, comments on the methods and organization of archæological studies in India. Reference to both these communications will be found on another page. A cognate question is raised by Colonel Germano da Silva Correia, who after a critical examination of the various theories of the racial origins of the peoples of India, put forward by anthropologists from the days of H. H. Risley onward, suggests that the methods of inquiry hitherto

pursued should be supplemented by a systematic survey of blood groups. Among other contributors Mr. Sasanka Sarkar puts forward a proposal for a classification of the nasal elevation index, and Dr. Biren Bonnerjea, profiting by his sojourn in the United States, discusses "Fish-Hooks in North America and their Distribution". We offer the new periodical a cordial welcome, and wish it a long and prosperous career.

Extension of Electric Power Supplies in U.S.S.R.

ACCORDING to "Russia Today" Press Service, the Commissariat of Power Stations of the U.S.S.R. is expending a sum of 1,056 million roubles on this purpose in the present year, when 882,000 kw. will be added to the capacity of the generating plants of the Union. The capacity of the power stations in the Ukraine has been augmented considerably, a notable addition being a 100,000 kw. turbine to the Zuyev Station, which is one of the largest in the U.S.S.R. Two large turbines have been added to the Moscow power system and three new heat and power stations are in course of construction in that city. The power system of the Urals has been augmented by a 50,000 kw. generator at the Central Urals Station near Sverdlovsk, which brings the capacity of this station up to 150,000 kw. A heat and power plant was recently put into operation at the Kamensk Aluminium Works in the Urals. Work on a large scale is also proceeding on hydro-electric power plants. This includes work on the world's largest power project, the Kuibyshev Hydro-Electric Centre (on the Samara Bend of the Volga), the power plant of which when completed will have a generating capacity of 3·4 million kw., and the hydro-electric power stations at Uglich and Rybinsk, two further links in the chain of the Greater Volga Project. The Uglich and Rybinsk stations will have a combined capacity of 440,000 kw. Construction is in progress on the first underground hydro-electric power station beyond the Arctic Circle, in the district of Kandalaksha, in the Murmansk Province. This station, which will have a capacity of 150,000 kw., will be the third power plant in the Soviet Far North. To provide power for the growing non-ferrous metal industry in the Altai Mountains, building has commenced for a generating station of 240,000 kw. capacity on the River Irtysh in Kazakhstan.

Precautions against Flooding in the London Tubes

IN order to protect railway and road transport services from the risks arising from air raids, London Transport, in conjunction with the Ministry of Transport, has undertaken a great programme of emergency work. The *Electrical Times* of October 19 states that the total cost of the programme, including that already completed at the outbreak of the War, will be about a million pounds. The most difficult part of the problem was how to protect the underground railways from flooding either from the Thames itself or from sewers or water mains where these are in close proximity to stations. There has been already a preliminary inspection of two examples of such protective works, namely, floodgates installed at Waterloo, where the tunnels of the Northern line go under the river, and work which has been done at King's Cross Underground, to guard against flooding from water mains and sewers. When the works are finished, all the stations and sections of line at present closed will be reopened and journeys on the Underground will be as safe as in peace time.

BOTH the floodgates installed at Waterloo and Charing Cross stations on the Bakerloo line are electrically operated. They enable the sub-fluvial sections of the lines between these stations to be isolated during an air raid and so the risk of damaging the under-river tunnels is avoided. Similar floodgates are being installed at Waterloo and Strand stations on the Northern line, which also runs under the Thames. Each gate is made of built-up steel of an overall thickness of thirteen inches and weighs very nearly six tons. In normal open position it is against the headwall of the station platform tunnel, against the tunnel mouth. It is made to slide horizontally into position across the tunnel mouth within a framework of cast iron and can be operated either electrically or by hand. For electrical operation control is by push-button. The gates would resist a force of more than 800 tons, which is several times greater than any possible pressure of water that might have to be borne. The gates on the Bakerloo line were actually closed during each of the three air raid warnings which marked the outbreak of war, the time taken to close them being less than three minutes. The gates were designed by W. T. Halcrow, consulting engineer, in conjunction with London Transport's engineers.

Commercial Irradiation of Food

IT is now sixty years ago since it was first discovered that bacteria are killed by exposure to sunlight, and that the bactericidal effect is due to rays of short wave-length. For medical purposes the use of such ultra-violet rays is now well known, but it is not generally known to what extent irradiation is used commercially in the preparation of foodstuffs, and the engineering devices that are employed for obtaining the ultra-violet rays. Until recently, sterilization of water by ultra-violet radiation has been hampered by the complexity of the equipment available (*Elect. Rev.*, Sept. 23). Recently, Messrs. Hanovia, Ltd., have brought out the new 'Uster' type of sterilizer, which uses a simple straight generating quartz mercury arc tube with a 700-watt loading. This starts automatically by an electronic discharge from activated metal electrodes. One of these units can deal with 600 gallons of fluid per hour. Mr. Harding, a director of E. Harding and Sons, Birmingham, states that in a bakery he finds that dough which has been subjected to ultra-violet rays during the seven to ten minutes it is mixing not only gives a loaf a better colour, owing to the slight bleaching action of the rays, but also causes a definite improvement in fermentation. Another application of ultra-violet radiation is to determine

quality or age by fluorescent effects. Many substances absorb ultra-violet rays and re-emit them as visible light of certain colours. The colours are specific and characteristic for each substance, but minute differences in chemical composition often cause large differences in the colours of the emitted light. An egg, for example, changes its colour from mauve-red when it is newly laid to pale blue as it grows older, and a mixture of margarine and butter appears an unmistakably different colour from pure butter.

A Geothermic Generating Plant

Italy has not confined its attention to developing hydro-electric power. At Bastardo in Umbria, Italian lignite is used to supply a large electric power station. In addition, there has recently been exploitation of the natural steam resources of the borax mines geysers in Tuscany. The Larderello geothermic electric station is the best known. Antonio Giordano, in an article published in the *Electrical Times* of October 19, gives an account of its growth from 1905 to the present time. Its capacity initially was 16,000 kilowatts. In the past twelve months, in association with the electrification of the Viareggio–Rome section of the Turin–Naples railway, running along the western Italian coasts, a new geothermic generating plant of 50,000 kw. capacity has been built. Its operation in the first few months has been so successful that the Borax Company of Larderello has placed orders for two new 12,000 kw. machines, for the necessary heat transformers, etc., and for the construction of a completely new power station at Castelnuovo, which will house five generating sets each of 12,000 kw. When the new developments are completed, the aggregate capacity of geothermic generating plants in Italy will amount to 135,000 kw., and the possibilities of further extensions are not exhausted. A problem connected with the exploitation of natural steam for power generation purposes is its purification. The difficulty was solved successfully by Prince Ginori Conti, chairman of the Larderello Company, by means of specially designed evaporator units. These consist of primary pipes through which the natural steam is circulated at a pressure of 3 kgm. per sq. cm., the pipes being immersed in water in a cylindrical tank. The energy is generated in the turbo-alternators at 25,000 volts and transmitted to the substations along the Viareggio–Rome railway, where it is converted to 3,000 volts direct current. The new station at Castelnuovo will also serve this railway.

Report of the Cambridge Observatory, 1938–39

The work carried out at the Cambridge Observatory under the directorship of Sir Arthur Eddington includes photo-electric observations for the purpose of testing the constancy of the light of stars similar in physical constitution to the sun (dwarf *G* stars). With the Northumberland equatorial, 165 measures of double stars were made, 51 being less than 1″ in separation. Dr. Woolley began laboratory experiments in preparation for a determination of the sun's apparent magnitude, planned, in conjunction with Mr. C. R. Davidson, to be carried out in South Africa in 1940. The apparatus had been brought to a stage at which it is possible to measure with a probable error of 0·01 mag. the transmission in sensibly monochromatic light of a dark glass cutting down three magnitudes. The polarization of a spectrograph was carefully determined in several wave-lengths, and a preliminary determination of the coefficient of reflection from an unsilvered glass surface was made. Both theoretical and observational work have been carried out by research students: Dr. M. Krook (Isaac Newton student) investigating certain problems involving non-coherent absorption; D. S. Evans concluding his work on the influence of Stark effect on the centre-to-limb variation of the contours of the Balmer lines; J. Jeffreys (Isaac Newton student) on photometric work in conjunction with Dr. Woolley's research on the sun's apparent magnitude, and H. Corben working on relativistic quantum theory. The Director has investigated the problem of how far the properties of a star of variable polytropic index are intermediate between those of polytropes corresponding to the two extreme indexes. This research is given in *Monthly Notices*, **99**, 4. By Grace of the Regent House on June 10, 1938, the Observatory was constituted a Department in the Faculty of Mathematics, and the Observatory Syndicate was discharged. The Syndicate had been in continuous existence for 109 years, an earlier Syndicate, appointed "for considering the propriety of building an Observatory", having met from 1818 until 1824.

Plant Hormones in Horticulture

The chemical recognition of plant hormones was quickly followed by the synthesis of substances capable of initiating the formation of roots in the stems of many plants. These substances have been used in plant propagation, causing almost in a 'catalytic' manner an acceleration of the rooting process accompanied by a more profuse root system. H. L. Pearse has now reviewed the work of thirty or more investigators who have endeavoured with considerable success to apply recent scientific discoveries to horticulture in this way ("Imperial Bureau of Horticulture and Plantation Crops. Technical Communication No. 12: Plant Hormones and their Practical Importance in Horticulture". By Dr. H. L. Pearse. Pp. 88. Bibl. 248. 3*s*. 6*d*.). There follows a valuable index showing approximately one thousand examples of propagation and the treatments used. This is not a complete list, and some difficulties in presenting the results of many workers in one table have been neatly overcome; but comparative reference would have been made easier by a standardized method of stating the concentrations employed. Results obtained by the additional use of vitamin B_1 (aneurin), known to influence the growth of excised roots *in vitro*, and other substances are also brought under review. The widespread use of aneurin is not recommended as yet, although at East Malling, as elsewhere, Pearse observed some stimulation in the subsequent growth of rooted cuttings which had received small quantities of

aneurin. The bulletin reports effects on other plant organs of these substances of possible application in horticulture. It is impossible to include all the latest work; there is no mention here of tetrahydronaphthylidene acetic acid, or of α-naphthylacetamide, recently shown to be active substances inducing cell division and root formation, or of plants failing to respond to treatment the anatomy of which is under investigation at Kew. This bulletin forms a well-balanced review of the subject to date, and its value is increased by its practical outlook.

Earthquake in Bulgaria

DURING the night of Thursday-Friday, October 19–20, strong earthquake shocks accompanied by a roaring sound were reported from Orisovo near Tchirpan in south Bulgaria. Some alarm was caused among the inhabitants but no damage was reported, and thus the earthquake appears to have been of about intensity VI on the Rossi-Forel scale (oscillation of chandeliers, visible disturbance of trees and shrubs, some startled persons leave their dwellings). This area is definitely seismic, and violent local shocks were reported from the same region on April 14 and April 25, 1928. According to K. Jankov, of the Observatory at Sofia, the most active region is to the south-east of Kustendil, where 1,420 shocks occurred between the years 1749 and 1936, some of these being so severe as intensity VII on the Rossi-Forel scale (overthrow of movable objects, fall of plaster, etc., but no damage to buildings). The majority of the shocks appear to have been of shallow focus, only affecting a small area and probably being due to slipping along an active fault. The present shock may have been of a similar nature.

Earth Tremor near Ottawa

AN earth tremor of intensity IV on the modified Mercalli scale (rattling of dishes, windows, doors) shook Ottawa on Friday, October 20. No damage was done. Small earth tremors are known to occur in eastern Canada from Baffin Bay to the Great Lakes including Newfoundland, though the nearest active epicentres to Ottawa appear to be those of Timiskaming (Quebec), where there was a shock on November 1, 1935, and in the region of the Saguenay River, where shocks have been recorded from as early as February 5, 1663, and continuing to the present time. Further information concerning the shock of October 20 is awaited from the Dominion Observatory at Ottawa.

Discovery of Comet Giacobina-Zinner

AN I.A.U. telegram from Copenhagen announces that this comet was discovered by van Biesbroeck on October 15 at 1h. 17·1m. U.T. Its position is given as R.A. 16h. 21m. 27·4s., N. Dec. 1° 18′ 53″. It is described as diffuse with central condensation, magnitude 15. In the "Handbook of the British Astronomical Association, 1939", the elements and ephemeris of this comet are given by Mr. F. R. Cripps, who applied the perturbations of Jupiter and Saturn to the 1933 elements. The comet is very close to the predicted position, and it is only necessary to make the corrections for perihelion passage 0·25d. later than that given in the "Handbook".

Rapidly Moving Spots on the Planet Jupiter

MR. B. M. PEEK, president of the British Astronomical Association and director of the Jupiter Section, has observed an outbreak of small dark spots on projections at the south edge of the North Temperate Belt of Jupiter. They appear to be rotating at such a speed that a complete rotation would take place in about 9 hours 50¼ minutes. There is a remarkable similarity between these spots and those which occurred in 1880, 1891 and 1929. Astronomers in possession of telescopes with apertures of 8 inches or more should be able to see these spots.

A Large Sunspot

A LARGE sunspot appeared over the sun's east limb on October 19 and is now crossing to the west limb, which it will reach on November 1. The time of central meridian passage of the spot is October 26·0, its latitude 8° south and its area, corrected for foreshortening, on October 20, was 1850 millionths of the sun's hemisphere.

The Night Sky in November

THE moon is new on November 11 at 7·9h. and full on November 26 at 21·9h. U.T. The bright star λ Geminorum (magnitude 3·6) is occulted on November 30, the disappearance as seen from Greenwich taking place at 2h. 22·8m. at position angle 102° from the north point, and the reappearance at 3h. 37·8m. at 282°. Mars, Jupiter and Saturn are bright planets in the evening or night sky. In mid-November, Mars souths at about 18½h., Jupiter at 20¼h. and Saturn at 22¼h. Jupiter is in conjunction with the moon on November 21 at 22h. and Saturn on November 24 at 1h. Uranus is in opposition on November 13, when its distance from the earth is nearly 1,731 million miles. Neptune, near the border between the constellations of Virgo and Leo, makes a near approach (about 20″) to the eighth magnitude star BD + 3° 2549. At about 21h. in the middle of the month, the Milky Way passes from the eastern to the western horizon through the zenith of London. The most distant celestial object that can be seen with the naked eye—the Great Nebula in Andromeda—is on the meridian at an altitude of 79°. Vega is the brightest star in the north-west quadrant of the sky and Capella the brightest in the north-east. The Pleiades cluster is well above the eastern horizon, and Orion is then just rising. The Leonid meteors should be looked for about November 14–16; their radiant point, preceding γ Leonis, rises about 23h. The meteors of this well-known shower are characterized by swift flights and their greenish colour. Light variations in the variable star Algol (β Persei) may be noticed about one and a half hours before and after the following times of primary minima: November 14d. 3·1h.; 16d. 23·9h.; 19d. 20·8h. and 22d. 17·6h.

Military Service and the Professional Institutions

Steps have been taken to ensure that members of all classes of the leading engineering and professional institutions, when called up for military service, will be posted to units in which their services will be best employed in the national interest and, in the case of graduates and students, to units in which the training will be of use to them on returning to civilian work. Members of engineering institutions should mention the fact when supplying particulars of their qualifications to 'interviewing' officers; a letter stating class of membership should be obtained from the Institution concerned for presentation to the officer.

Modern Wireless Communications

In response to a request and with the view of meeting the needs of students and others who may wish to qualify for possible future service in the uniformed and non-uniformed radio branches of the Defence Forces, arrangements have been made by the Royal Institution for a series of lectures on modern wireless communications. The course will consist of twelve afternoon lectures, commencing on October 31, and will be given by Prof. C. L. Fortescue, Dr. R. L. Smith-Rose and Dr. E. V. Appleton. They will deal with important aspects of the installations, transmission of the signals and the phenomena of radio wave propagation. Tickets, for which there will be no charge, may be obtained from the General Secretary, Royal Institution, Albemarle Street, London, W.1.

The British Empire Naturalists' Association

The British Empire Naturalists' Association has decided to suspend further publication of its quarterly journal *Country-Side* during the war, but in order to continue the maximum amount of activities, full power has been given to the various branches to carry on under their own organization until such times as normal conditions return. There will be circulated, however, the usual quarterly issues of the *Branch News*, in order to keep branches in contact with headquarters. The decision was made not without regrets, but the view maintained was that by conserving funds now, the Association would be in a stronger position to resume its full activities when peace returns, rather than to weaken itself by struggling against the rising costs and difficulties of voluntary labour. Numerous provincial natural history societies have cancelled their programmes, and others have adopted a method of meeting in the afternoons.

Institute of Metals

During the War the Institute of Metals is continuing its activities, other than those of a social character. The headquarters in Grosvenor Gardens, London, remain open, and the Joint Library and the Information Department are available to members. The *Monthly Journal* will continue to publish original papers, and also to provide abstracts, the importance of which becomes more apparent as members find it difficult to obtain access to technical journals.

Royal Geographical Society

The Royal Geographical Society will, so long as is possible, carry out its programme of meetings for the session, but at modified times. All meetings will be at 5 p.m.; the evening meeting programme on alternate Mondays, the afternoon meeting and geographical films programme on the intermediate Mondays. At the first meeting, on Monday, October 30 at 5 p.m., Mr. F. Kingdon Ward will read a paper on "Six Months in the Assam Himalaya". The Asia Lecture will be delivered by Dr. G. M. Lees on November 27.

Announcements

Mr. Percy R. Lowe has been awarded the Verner von Heidstam Gold Medal of the Royal Swedish Academy of Sciences in recognition of his "important and successful endeavours to further the protection of the world's fauna, endeavours of great benefit also to the migratory birds of Sweden".

At the annual statutory meeting of the Royal Society of Edinburgh held on October 23, the following officers were elected: *President*, Prof. E. T. Whittaker; *Vice-Presidents*, Principal J. C. Smail, Prof. J. Walton, Dr. James Watt, Dr. Leonard Dobbin, Mr. J. A. Inglis and Prof. R. Stockman; *General Secretary*, Prof. James P. Kendall; *Secretaries to the Ordinary Meetings*, Dr. A. C. Aitken and Prof. R. J. D. Graham; *Treasurer*, Dr. E. M. Wedderburn; *Curator of the Library and Museum*, Dr. J. E. Mackenzie.

The Rockefeller Foundation has recently awarded two grants, of 350,000 and 90,000 dollars, to the Johns Hopkins University School of Medicine, Baltimore. The larger sum is to be used over a ten-year period to equip and maintain a department of preventive medicine, while the second grant will be utilized as a research fund to be distributed among departments and to projects which stand in greatest need of carrying out research programmes.

Messrs. Flatters and Garnett, Ltd., 309 Oxford Road, Manchester, 13, have issued an abridged list of their microscope slides, dealing chiefly with biological subjects. This includes two sets, of thirty-six slides each, suitable for the zoology and botany respectively of Higher School Certificate and 1st M.B. students. The firm has a stock of 30,000 slides; no change has been made in prices.

Prof. S. Chapman has noted some misprints in his article on the meeting of the International Union of Geodesy and Geophysics published in Nature of October 21: p. 717, col. 1, line 10 from bottom, for "Signole" read "Signore"; line 9 from bottom, for "Lütschy" read "Lütschg"; p. 718, col. 2, line 5 from end of article, for "Sánchey" read "Sánchez". He also intended to emphasize the complete absence of French and Italian delegates and of Russian visitors, referred to in the article.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

Notes on points in some of this week's letters appear on p. 755.

Correspondents are invited to attach similar summaries to their communications.

Taste-testing the Anthropoid Apes

At the recent International Congress of Genetics at Edinburgh, in the course of discussions on the possibility that the blood-group frequencies found in man were determined by a balance of selective influences, it occurred to one of the authors that evidence on the parallel possibility for taste-testing could be obtained by testing the anthropoid apes.

By the courtesy of Prof. F. A. E. Crew and Dr. Gillespie of the Edinburgh Zoo, a preliminary test was carried out before the Congress ended, which was successful in showing that, when the animals are calm and free from interference by others in the same cage, the test can be made without ambiguity, and that both tasters and non-tasters exist among the chimpanzees.

We have since tested nearly all the anthropoid apes in the Zoological Society's collections at Regent's Park and Whipsnade. The solutions used contained 2 per cent sucrose to make them moderately attractive, and, except for this, were equivalent to Nos. 3, 6 and 9 of the standard series used at the Galton Laboratory, where they were prepared. They contained respectively 6¼, 50 and 400 parts per million phenyl-thiocarbamide. Human tasters would generally find the first perceptibly bitter, but not necessarily unpleasant if the sugar were desired; the second would be, to most tasters, unpleasantly bitter, and the third decidedly so. Non-tasters might notice some slight bitterness at the strongest level. The apes tested must have similar sensory perceptions at these strengths, for those classified as non-tasters continued to accept the strongest solution, while the 'tasters' showed reluctance or aversion, sometimes with the weak, and always with the medium solution. The strong solution was used whenever possible for confirmation.

With the exception of one chimpanzee, which was too shy to be tested, the results are shown in the following table (E, R, and W stand for Edinburgh, Regent's Park and Whipsnade):

Chimpanzees tested

	Females E R W	Total	Males E R W	Total	Both sexes
Tasters ..	2 7 2	11	4 2 3	9	20
Non-tasters ..	1 1 1	3	1 3 –	4	7
Total ..	3 8 3	14	5 5 3	13	27

Thus the chimpanzees show 7 non-tasters out of 27, or 26 per cent. Experience with man also gives regularly about 25–30 per cent.

The young female Jaqueline, both of whose parents are in the Regent's Park collection, and both non-tasters, was omitted from the table of frequencies, since her reaction as non-taster, while it confirms the genetical similarity of the situation in the apes and in man, adds nothing to our knowledge of the gene frequency in the apes.

With the orang-utan we found one male non-taster at Edinburgh, and two tasters, male and female, at Whipsnade. Two male gorillas at Regent's Park were both tasters. Two Whipsnade specimens of the gibbon (*Hylobates concolor*) were both tasters, but *H. lar lar* and *H. lar agilis* at Regent's Park were non-tasters. Numerous tests on primates and other mammals are in progress.

The existence of a dimorphism in the taste test, parallel to that known in man, in at least two of the manlike apes, is a most remarkable fact. Its significance is emphasized by the circumstance that, certainly in the chimpanzee, the proportion of tasters to non-tasters is nearly the same as in human populations, which, as Boyd has shown, vary somewhat among themselves. Without the conditions of stable equilibrium it is scarcely conceivable that the generatio should have remained the same over the million or more generations which have elapsed since the separation of the anthropoid and hominid stocks. The remarkable inference follows that over this period the heterozygotes for this apparently valueless character have enjoyed a selective advantage over both the homozygotes, and this, both in the lineage of the evolving chimpanzees and in that of evolving man. Wherein the selective advantages lie, it would at present be useless to conjecture, but of the existence of a stably balanced and enduring dimorphism determined by this gene there can be no room for doubt.

R. A. Fisher.

Galton Laboratory,
(now at Rothamsted Experimental Station, Harpenden, Herts).

E. B. Ford.

University Museum, Oxford.

Julian Huxley.

Zoological Society, London.

Oct. 14.

Acetylphosphate and Pyruvate Oxidation

Lipmann has recently reported[1] that adenylic acid is partially phosphorylated to adenosine polyphosphate by preparations of *Bacterium Delbrückii* in the presence of acetylphosphate, and suggested that this compound may be an intermediate in the oxidation of pyruvic acid generally. If so, acetylphosphate should give an increased oxygen uptake with enzyme preparations which oxidize pyruvic acid completely.

We have prepared acetylphosphate by the method of Kämmerer and Carius[2] and confirmed Lipmann's observation that the stability of the bound phosphate is similar to that of phosphocreatine. Traces of Ag^+ left in solution strongly inhibit respiration; we therefore removed Ag^+ by addition of sodium chloride and adsorption on kaolin. A neutralized solution containing a mixture of mono-, di, and triacetylphosphate was used.

Acetylphosphate is not oxidized by a dialysed brain dispersion[2] (pigeon) in the presence of phosphate, fumarate, and adenylic acid. A typical experiment is given in Table 1. Each sample contained 1·5 ml. enzyme (dialysed 4 hours), phosphate buffer (*p*H 7·3), 1·2 mgm. sodium fumarate, and 1 mgm. adenylic acid (total volume of 2 ml.).

Table 1.

μl oxygen uptake in 30 minutes (air, 38°).

Blank	Acetyl-P (1·12 mgm. P)	2 mgm. sodium pyruvate	Acetyl-P + sodium pyruvate
89	66	496	450

Experiments with muscle extract, in which a rapid transfer of phosphate to adenylic acid from phosphate donators such as phosphopyruvic acid takes place, have been negative with acetylphosphate. The experiments of Table 2 were carried out with an acetone powder extract from rabbit's muscle dialysed 6 hours. Each sample contained (in 1·5 ml.) 1 ml. extract plus phosphate buffer (*p*H 7·3), adenylic acid (with 0·35 mgm. P), and either phosphoglyceric acid (0·8 mgm. P) or acetylphosphate (1·95 mgm. P) as phosphate donators. Phosphate was determined colorimetrically by the method of Lohmann and Jendrassik.

Table 2.

P donator	Incubation at 30°	mgm. direct P	mgm. pyrophosphate P
Phosphoglyceric acid	5 min.	0·37	0·49*
" "	30 "	0·38	0·56*
Acetyl-P	30 "	2·16	0·00
"	60 "	2·30	0·04

*Theoretical value for complete phosphorylation of added adenylic acid to adenosine triphosphate, 0·70 mgm. P.

These results indicate that acetylphosphate is neither an intermediate in the oxidation of pyruvic acid by brain nor does it act significantly as a donator of phosphate to adenylic acid in muscle extract. They do not exclude the possibility that acetylphosphate might be an intermediate in the dehydrogenation of pyruvic to acetic acid by preparations of *Bacterium Delbrückii*, but the fact that some acetic acid is produced when pyruvate is oxidized by brain[4], and the indirect nature of Lipmann's evidence, make it more probable that there is some other, as yet unknown, phosphorylated intermediate common to both bacteria and animal tissues. The existence of such an intermediate is strongly suggested by the observation of Banga *et al.*[3] that adenylic acid is involved in a stage of pyruvate oxidation by brain beyond that of oxidative decarboxylation.

We are indebted to the Nuffield Trustees and the Rockefeller Foundation for grants in aid of this work.

S. OCHOA.
Department of Biochemistry, R. A. PETERS.
Oxford. Sept. 22. L. A. STOCKEN.

[1] NATURE, 144, 381 (1939).
[2] *Ann.*, 131, 165 (1864).
[3] Banga, Ochoa and Peters, NATURE, 144, 74 (1939).
[4] Long, *Biochem. J.*, 32, 1711 (1938).

Oxidation of Methyl Esters of Monocarboxylic Fatty Acids by Normal and Neoplastic Tissue

THE metabolism of the fats in tumours has been little studied. Haven[1], feeding elaidin to rats, the method used by Sinclair[2] in classifying phospholipids into the metabolic and the non-metabolic type, found that the phospholipids of tumours are mainly of the non-metabolic type, having to do with cellular structure rather than with the burning of fatty acids for energy. According to Kisch[3], the Jensen sarcoma does not oxidize the low fatty acids. I have observed[4] that the oxygen uptake of slices of various experimental and human tumours is not increased when saturated and unsaturated monocarboxylic fatty acids in the form of sodium salts are added to the medium, and that in no instance were acetone (ketone) bodies formed. The β-hydroxybutyric acid, on the other hand, is oxidized into aceto-acetic acid.

The latter data exclude the fact that the neoplastic cell can β oxidize fatty acids. My aim was to find out whether the tumour could oxidize fatty acids by means of ω-oxidation.

I have studied manometrically the oxidation of methyl esters of monocarboxylic fatty acids from C_1 to C_8 in comparison with the corresponding free acids, in the presence of tissue slices of liver, kidney, spleen, brain cortex, striated muscle, Rous I sarcoma, round cell chicken sarcoma, and Ehrlich adenocarcinoma. It has been found that, without exception, the oxygen consumption of normal tissue slices is increased by fatty acids esters much more than by the free acids. For example, some esters increased the oxygen uptake in the liver eight times, in the brain cortex eleven times, and in the spleen seventeen times more than the corresponding acids. As a rule, the oxygen uptake increases as the fatty chain increases up to a maximum at about C_6–C_7, and decreases at about C_8, owing to the low solubility in water of this ester. With methyl formiate—in connexion with which a true ω-oxidation is obviously impossible—it is the ester which is mostly burnt in certain tissues (spleen, brain, striated muscle). Only the fatty acid component of the esters is burnt, whereas the alcohol component is not.

Neoplastic tissues do not oxidize the free fatty acids but actively oxidize the corresponding esters. The neoplastic cell in which enzymes of β-oxidation are lacking—with the exception of the enzyme which transforms the secondary alcoholic group of the β-hydroxybutyric acid into a ketonic group—can, by means of the ω-oxidation enzymes, use the fats as a source of energy.

E. CIARANFI.
Institute of General Pathology,
University of Naples,
Italy. Sept. 14.

[1] Haven, F. L., *J. Biol. Chem.*, 118, 111 (1937).
[2] Sinclair, R. G., *J. Biol. Chem.*, 111, 515 (1935).
[3] Kisch, B., *Biochem. Z.*, 253, 379 (1932).
[4] Ciaranfi, E., *Amer. J. Cancer*, 32, 561 (1938).

A Cell-free Enzymatic Model of *l*-Amino-acid Dehydrogenase ('*l*-Deaminase')

ATTEMPTS to obtain cell-free enzyme preparations of animal origin effecting deamination of the *monocarboxylic* *l*-amino acids have hitherto been practically unsuccessful. (Specific enzymes deaminizing *d*-amino-acids and *l*-amino *dicarboxylic* acids have been obtained in solution and purified by several authors.) H. A. Krebs[1] attributes the deamination of *l*-amino-acids to an enzyme, termed '*l-deaminase*', depending for its activity upon the integrity of cell structure and rapidly deteriorating when the cells are damaged.

It appears from the data of Krebs that '*l*-deaminase' is even more sensitive to the dilution of cell-contents in ground tissue suspensions than to cell destruction as such, and further, that the *di*carboxylic amino-acids are oxidized at a very much higher rate than the *mono*carboxylic ones (in fact, *l*-aspartic acid was the substrate used in most experiments).

These facts point to the complex nature of '*l*-deaminase'. In a recent paper[2], one of us (A.B.) suggested that deamination of monocarboxylic amino acids might proceed by way of their transamination with α-ketodicarboxylic acids, followed by deamination of the resulting amino*di*carboxylic acids, owing to co-operation of two enzyme systems: glutamic or aspartic aminopherase, and glutamic or aspartic dehydrogenase (with their respective co-enzymes, or hydrogen and amino carriers). The chain of reactions involved would be a reversal of the mechanism of amino acid synthesis in the animal body recently suggested by Euler and associates[3].

In support of this hypothesis, we have succeeded in constructing, from the above-stated constituents, a cell-free, almost water-clear enzymatic model system, deaminizing *l*(+)alanine at a fairly high rate under aerobic conditions, with pyocyanine as autoxidizable hydrogen carrier. The complete system consists of: (*a*) 2 ml. purified and dialysed glutamic dehydrogenase (from ox liver, after Euler[3]), (*b*) 3–4 ml. purified and dialysed glutamic aminopherase (from pig heart, after M. Kritzmann[4]); (*c*) 2–20 mgm. (14–138 mol. × 10^{-6}) α-ketoglutarate; (*d*) 2·5 mgm. cozymase (of about 60 per cent purity, after Ohlmeyer); (*e*) 0·3 mgm. pyocyanine; (*f*) 15–20 mgm. (170–225 mol. × 10^{-6}) *l*(+)alanine; (*g*) *M*/15 phosphate buffer, *p*H 7·6 to 10 ml. total volume.

In the complete model system, 10–15 per cent of the total amino-nitrogen is liberated as ammonia in the course of two hours shaking in an atmosphere of oxygen (Table 1).

TABLE 1.

Expt. No.	I	II	III	IV (3 hours)				V (4 hours)
α-Ketoglutarate (mols × 10^{-6})	160	135	117	117	58	29	14	6
	Ammonia liberated in 2 hours, mol. × 10^{-6}							
Complete system	23·6	12·9	24·3	23·6	21·0	20·0	17·0	19
Without glutamic aminopherase	0	1·6	—	—	—	—	—	—
Without glutamic dehydrogenase	5·6	0·7	2·0	0	—	—	—	—
Without ketoglutarate	0	0	0	0	—	—	—	—
Without cozymase	—	0	—	0	—	—	—	—
Without alanine	0	0·7	0·7	0	—	—	—	—
Without pyocyanine	0	—	—	—	—	—	—	—

In the same system, the direct deamination of *l*(+)glutamic acid proceeds more than twice as rapidly. Methylene blue may be used instead of pyocyanine, but the latter is more efficient. Practically no ammonia is formed from alanine if any one of the constituents is omitted. With low concentrations of ketoglutarate, it is advisable to add sodium arsenite in order to prevent breakdown of the keto-acid (glutamic dehydrogenase proved resistant to arsenite, like '*l*-deaminase').

Whether the 'indirect' mechanism of *l*-amino acid oxidation here discussed is actually at work in the metabolism of living tissues must be ascertained by special studies, now in progress in this laboratory.

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S. M. BYCHKOV.

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A. M. Gorky Institute of
Experimental Medicine,
Moscow.
August 12.

[1] Krebs, H. A., *Biochem. J.*, **29**, 1620 (1935).
[2] Braunstein, A. E., NATURE, **143**, 609 (1939).
[3] Euler, H., and Adler, E., *et al.*, *Z. physiol. Chem.*, **254**, 61 (1938).
[4] Kritzmann, M. G., *C.R. (Doklady) Acad. Sci. U.R.S.S.*, **21**, 42 (1938); *Biochimia*, **3**, 603 (1938).

Localization of Electrolytes in Muscle

THE volume of the free interspaces within the freshly excised sartorius of the frog has a mean value of 9 ml./100 gm. when measured by inulin, agreeing with the results from the magnesium method[1]. (The inulin method when applied to rabbit muscle[2] after preliminary injection into the blood stream gives 7 ml./100 gm.)

Comparing this figure with that for chloride in muscle, which is 14 per cent that in the plasma, it will appear that all the chloride is not free in the interspace water. That the difference is mostly due to the penetration of the fibre membrane by chloride is shown by the evidence now accumulated in this laboratory. Here some of the facts immediately related to the chloride and sodium localization are given.

(*a*) When immersed in sulphate solution (1·3 per cent sodium sulphate) the chloride in the freshly excised sartorius comes out entirely within about twenty minutes, but when immersed in glucose solution (3·2 – 3·8 per cent) it diffuses in two parts. The first, corresponding to the interspace fluid, comes out rapidly, nearly if not quite as rapidly as in sulphate. The second and comparatively small fraction takes upwards of three hours for complete emergence. During the first period the potassium diffusing out is much less than either chloride or sodium, but during the second period it is considerably greater.

(*b*) Even when immersed in a solution resembling as closely as possible the inorganic composition of plasma (including carbon dioxide) with glucose to maintain the osmotic balance, the chloride in the sartorius increases to 27 per cent of the external chloride within about twenty minutes and then remains steady. During this time sodium increases by only 4 per cent of the external sodium, and this is accounted for by a corresponding loss of potassium. There is no correspondence between the movement of sodium and chloride, which negatives an adsorption explanation of the increased chloride, but is easily accounted for by an interchange with other permeable anions within the fibre.

The chloride, so increased by preliminary immersion, diffuses into glucose solution in two parts as before, the second being now much increased over the similar fraction of the normal content, whereas the first remains the same.

(*c*) Sodium diffuses from the fresh sartorius into glucose solution in a very similar manner to chloride, the second sodium fraction taking likewise three to four hours for complete emergence.

(*d*) When all or practically all the sodium or chloride has emerged from the sartorius into glucose solution, the potassium is still present in considerable quantity (50–60 per cent of the original content) and continues to diffuse out.

We may deduce that about 9 per cent of the external sodium or chloride is contained in the free interspaces and can diffuse out rapidly, the remainder

of the chloride and sodium being contained within the fibre. The fact that practically all the sodium and chloride diffuse out with less than half the potassium shows that a considerable proportion of of this exists in some region free from sodium and chloride or with a mere trace of chloride. This region we may identify with the myofibril, and regard sodium as being present only in the sarcoplasm.

The presence of a second membrane with somewhat different permeabilities is shown by the fact that in Ringer at 2–3 C. potassium has diffused out to one half or so of its full amount, and sodium has entered in corresponding quantity, but within the next three days there is almost no change in the potassium or sodium content. After four or five days there is a sudden emergence of the remaining potassium and corresponding entrance of sodium accompanied by considerable swelling.

The above research has been supported by a grant to one of us from the Irish Medical Research Council.

E. J. CONWAY.
University College, F. KANE.
Dublin. P. BOYLE.
Sept. 1. H. O'REILLY.

[1] Conway, E. J., and Cruess-Callaghan, G., *Biochem. J.*, **31**, 828 (1937)
[2] Conway, E. J., and Fitzgerald, O. (unpublished observations).

Source of the Moulting Hormone in Rhodnius (Hemiptera)

Two known factors are concerned in the control of growth in Rhodnius: a 'moulting hormone' which initiates cell division and subsequent ecdysis, and an 'inhibitory hormone', secreted in the first four nymphal stages, which prevents the development of imaginal characters. The inhibitory hormone is secreted by the corpus allatum[2].

I originally suggested that the moulting hormone might come from the same gland[1], but I have been unable to produce satisfactory proof of this. Recently I have re-investigated the question by transplanting isolated corpora allata, brains and parts of brains from 5th stage nymphs shortly after the 'critical period' into 4th stage nymphs decapitated at twenty-four hours after feeding.

In no case (11 experiments) did implantation of the corpus allatum and the associated sympathetic ganglion induce moulting; in 15 out of 17 experiments, moulting was induced by implantation of the brain. When different parts of the brain were tried, negative results were obtained with the subœsophageal ganglion, the optic lobes and the ventral half of the central mass of the brain; large pieces of fat body also gave negative results.

Positive results were obtained only with the dorsal half of the central mass of the brain. This is the region in which Hanström has recently demonstrated in Rhodnius the presence of peculiar large nerve cells which may have a secretory function[3]. I have confirmed the presence of these cells but have been unable to satisfy myself that they show histological signs of increased secretory activity during moulting.

V. B. WIGGLESWORTH.
London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

[1] *Quart. J. Micro. Sci.*, **77** (1934).
[2] *Quart. J. Micro. Sci.*, **79** (1936).
[3] *Lunds Univ. Arsskrift, N.F.*, **34**, No. 16 (1938).

A Peculiar Phenomenon Observed in Larval Populations of the Flour Beetle *Tribolium confusum* Duv.

I HAVE observed that if small masses of coarsely sifted whole-wheat flour (64 gm. in a 150 c.c. beaker) are seeded with more than 800 eggs of the flour beetle *Tribolium confusum* Duv., and maintained at a suitable temperature and relative humidity (27° C., and 75 per cent r.h.), a peculiar distortion of the originally flat, level, upper surface of the flour mass occurs. There is a slight initial bulging upward commencing on the sixth day when the eggs hatch, no doubt due to the loosening of the flour by larval movement. This bulging increases up to about the twenty-first day, as shown in Fig. 1. There then takes place a more or less rapid moulding of the surface into the rather graceful form seen at the bottom of Fig. 1, and in Fig. 2, which is a photograph of a median vertical section of a culture on the twenty-eighth day.

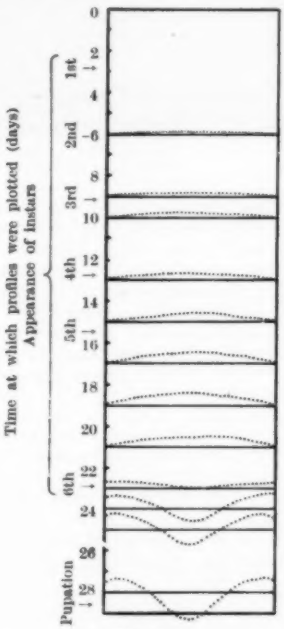

Fig. 1.

THE HORIZONTAL LINES ARE THE ORIGINAL FLOUR SURFACE.

It will be noted from Fig. 1 that the distortion is not due to a mere sinkage of the central parts, but to a radial translocation of the flour, the circumferential drop being due, it is believed, to peripheral migration of the larvæ. The degree of distortion of the original flat surface depends on the number of larvæ present, being almost imperceptible with 600, marked with 800, and extreme with 1,600, there being almost 0·75 inches between the highest and lowest parts at this last concentration. With more than 1,600, interference between the moving larvæ occurs, and the figure is less marked.

The effect is dependent also on the diameter of the vessel, the optimum diameter appearing to be about 2 in., which is that of a 150 c.c. beaker. The effect does not occur if the flour is very fine, probably due to higher internal friction in such flour. Vertical

X-ray photographs do not disclose any marked non-random distribution of the larvæ, though some small evidence of peripheral migration is afforded by the presence of circumferential tunnels.

Fig. 2.

This problem is being investigated experimentally, and also from the point of view of a mathematical analysis, and will be reported on later in a publication made elsewhere. I wish to acknowledge the financial support of the National Research Council of Canada and the Science Research Committee of Queen's University in connexion with the work on the growth of populations of Tribolium, of which this is a part.

JOHN STANLEY.

Queen's University,
Kingston, Ontario.
Sept. 1.

Limits of Validity of Quantum Mechanics

WE proposed some years ago[1] a modification of the formalism of the quantum theory for the cases in which the following condition is satisfied:

$$\xi = \left|\left(\vec{p}_1 - \vec{p}_2\right)^2 - \frac{1}{c^2}\left(E_1 - E_2\right)^2\right| \gtrsim p_0^2 \qquad (1)$$

$$p_0 = \frac{h}{r_0} \sim 137\, mc,$$

where $\vec{p}_1$, E_1 and $\vec{p}_2$, E_2 are 4-vectors corresponding to two states of a particle in a quantum transition, and r_0 is a universal length, $r_0 \sim 10^{-13}$ cm.

Such a method consists in the introduction of some relativistic 'convergency-factors' $G(\xi)$, which $\to 0$ if $\xi \to \infty$ and which give rise to convergent results instead of many divergent results of the present quantum theory. In the cases where $\xi < p_0^2$, $G(\xi) \cong 1$ and the rules of the ordinary quantum theory are obviously obtained. This condition $\xi < p_0^2$ is therefore the condition of validity of the quantum mechanics and it can be examined independently of the method of the 'convergency-factors'.

Let us show that by operating within the limits of validity of the present quantum theory, the measurement of a co-ordinate x cannot be made with $\Delta x < r_0$. Such a measurement can only be performed by using incident waves of a wave-length $\lambda < r_0$ and by operating in such a manner that the scattered radiation which enters the measuring apparatus (for example, the Heisenberg microscope) has also a wave-length[2] $\lambda < r_0$; $|\vec{p}_2| > p_0$.

We have indeed:

$$\Delta x \cong \frac{\lambda_2}{\sin \alpha}. \qquad (2)$$

Thus we can suppose

$$|\vec{p}_1| \gtrsim |\vec{p}_2| \gg p_0 > mc,$$

and, from the condition of validity of quantum theory $\xi < p_0^2$, we obtain the following condition for the angular deviation Θ in the collision process:

$$\xi = \vec{p}_1^{\,2} + \vec{p}_2^{\,2} - 2\,|\vec{p}_1|\,|\vec{p}_2|\cos\Theta - (E_1 - E_2)^2 \sim$$

$$2\,|\vec{p}_1|\,|\vec{p}_2|\,(1 - \cos\Theta) < p_0^2. \qquad (3)$$

$$\left(2\sin\frac{\theta}{2}\right)^2 < \frac{p_0^2}{|\vec{p}_1|\,|\vec{p}_2|}; \quad \theta < \frac{p_0}{p_2}; \quad (|\vec{p}_2| = p_2).$$

Only by operating within these limits can we be sure of not introducing unknown phenomena and of being able to apply the ordinary rules of the quantum theory. But in the case we are dealing with, when the measuring apparatus is, for example, a γ-ray microscope, we can only use scattered particles within a small angle α. The numerical aperture of the microscope sin α must satisfy the condition

$$\sin\alpha < p_0/p_2. \qquad (4)$$

From (2) and (4) we have

$$\Delta x \gtrsim \left(\frac{h}{p_2}\right)\Big/\left(\frac{p_0}{p_2}\right) = r_0. \qquad (5)$$

The nuclear phenomena belong to the condition $\xi \sim p_0^2$. It is very remarkable that, in the cosmic radiation, phenomena belonging to the condition $\xi \gg p_0^2$ have not been observed so far. This seems to justify the assumption that such phenomena have a very small probability of occurrence, a fact in agreement with the assumptions of the method of the 'convergency-factors'[3].

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[1] *Z. Phys.*, **88**, 92 and 547 (1934). *C.R.*, **202**, 833 (1936). *La Ricerca Scientifica*, 8. II, Anno IX, 1.
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[3] NATURE, **142**, 393 (1938). *C.R.*, **207**, 358 and 421 (1938).

Hyperfine Structure in the Spark Spectrum of Iodine

IN a recent short note[1], Th. Schmidt states that he cannot agree with my measurements and conclusions relating to the hyperfine structures of two lines in the iodine spark spectrum. In my analysis of 33 terms in this spectrum[2], I found that in eight there were deviations from the interval rule. Amongst these the terms with $J = 2$ did not fit the quadratic interaction law of the type suggested by Schüler and Schmidt[3] and by Casimir[4], but could be fitted into a cubic law:

$$E = A + B\cos IJ + C\cos^2 IJ + D\cos^3 IJ.$$

In particular, I have found it necessary to employ this formula for the structure of $(^3D)\ 6s\ ^3D_2$, which

has been derived with a high degree of exactness from the line 6127. This same line has been re-measured by Schmidt, who obtains very different results, leading to a different term analysis. An entirely independent analysis for the term in question has recently been published by Murakawa[5], who has achieved high resolution in analysing the structures of the lines 5407, 5678, both of which involve the above term.

In the accompanying table are given the intervals derived for $(^1D)\ 6s\ ^1D_2$, by Schmidt, Murakawa and myself. In addition, I have independently analysed Murakawa's *experimental* data and have enclosed the results in brackets. It should be pointed out that the nature of the lines 5407, 5678 is such that errors due to overlapping might cause small displacements, but *only* in the lower F levels.

F	Schmidt	Murakawa	Tolansky
$\frac{3}{2}$			
$\frac{5}{2}$	246	236 (235)	234
$\frac{7}{2}$	227	236 (237)	238
$\frac{9}{2}$	182	181 (181)	185
$\frac{1}{2}$	117	114 (114)	110

It will be observed that Schmidt's data differ considerably from those of Murakawa and myself, particularly in the first two intervals, which are the very ones in which the accuracy of my measurements is at its best ($\pm$ 1 unit). It appears that the position of $F = 7/2$ is incorrectly given by Schmidt, since Murakawa and I are in agreement.

I wish to re-emphasize strongly what I have previously stated, namely, a cubic interaction formula need not of necessity imply the existence of a nuclear *octopole* moment. I suggest that it is possible that the existence of configuration interaction will convert the quadratic expression characteristic of electrical quadrupole moment into a cubic interaction law, the size of the cubic term depending upon the degree of configuration interaction. It is to be hoped that theoretical workers will examine this effect, since, if configuration interaction can distort hyperfine structures, *no* reliance can be placed upon any calculated nuclear electrical quadrupole moment until the existence of such interaction can be excluded with certainty.

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Sept. 6.

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[2] Tolansky, S., *Proc. Roy. Soc.*, A, **170**, 205 (1939).
[3] Schüler, H., and Schmidt, H., *Z. Phys.*, **98**, 239 (1939).
[4] Casimir, H., *Physica*, **7**, 719 (1935).
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Points from Foregoing Letters

HUMAN beings can be divided into two groups according as they experience a bitter taste or not with dilute solutions of phenylthiocarbamide, and the proportion of 'non-tasters' to 'tasters' is regularly 25–30 per cent. Tests by R. A. Fisher, E. B. Ford, and J. Huxley on manlike apes in zoological collections show that some of them cannot taste phenylthiocarbamide. The proportion of non-tasters in the chimpanzee agrees with that in man. It appears that in the ancestries both of man and of the apes a balance of selective forces must have maintained the gene ratio at a nearly constant value.

S. Ochoa, R. A. Peters and L. A. Stocken find that acetylphosphate is not oxidized by brain enzyme preparations and does not transfer its phosphate to adenylic acid in muscle extracts. They conclude that the compound is not an intermediate in the oxidation of pyruvic acid by brain.

E. Ciaranfi finds that the esters of fatty acids increase the oxygen consumption of normal tissue slices much more than the fatty acids themselves; only the fatty acid component of the esters is consumed. Neoplastic tissues do not oxidize the free fatty acids but actively oxidize their esters.

A. E. Braunstein and S. M. Bychkov claim that they have obtained a cell-free enzymatic system able to deaminize *l*-alanine at a fairly high rate under aerobic conditions and with pyocyanine as autoxidizable hydrogen carrier.

Using an inulin method, the volume of the interspaces in the excised sartorius of the frog is shown by E. J. Conway *et al.* to be 9 ml./100 gm. muscle, whereas the chloride represents 14 per cent of the external concentration. This, supported by other facts, indicates the presence of chloride within the fibres. Evidence is given for the localization of sodium within the sarcoplasm and the existence of a second membrane, presumably that of the myofibril, which can, under certain conditions, show permeabilities differing from those of the sarcolemma.

V. B. Wigglesworth has induced moulting in decapitated nymphs of Rhodnius by implantation of the brain removed from other nymphs during the 'critical period'. Implantation of the corpus allatum and sympathetic ganglion gave negative results.

When a small quantity of coarsely sifted wholewheat flour in a beaker is seeded with eggs of the flour beetle and conditions favourable to development are maintained, J. Stanley finds that the surface of the flour gradually assumes a distinctive form. The effect appears to be due to radial movement of the flour.

By the introduction of certain relativistic convergency factors, G. Wataghin deduces the condition for the rules of the ordinary quantum theory to hold, and examines these conditions by an independent method.

S. Tolansky criticizes the hyperfine structure measurements in the iodine spark spectrum published by Th. Schmidt. It is suggested that a quadrupole quadratic interaction formula might be converted into a cubic formula, as a result of configuration interaction.

RESEARCH ITEMS

Finger Weaving in Canada

THE question whether the brightly coloured sash and garters of the Indians of Canada are of native origin and whether finger weaving, which they involve, is a pre-Columbian technique or an introduced feature which adapted itself to new surroundings, is considered by Marius Barbeau in "The Assomption Sash" (National Museum of Canada: *Bull.*, 93, *Anthrop. Series*, **24**; 1939). The Assomption and Achigan sashes are so called from their place of manufacture as a home industry of the French Canadians for the fur traders of Montreal to barter with the Indians. They were also known as arrow sashes from their pattern, which includes a row of continuous arrow heads; and although there were others known by appropriate names, the arrow sash became the standard type, when the Hudson Bay Company nearly forty years ago began to import a cheap manufactured sash from England, as it does still; this ruined the home industry, and attempts have been made recently to revive it. Research directed to the character of the older sashes preserved in museums in America and Europe, and study of the technique of finger weaving and its distributions has failed to produce evidence of its practice in Europe, which would account for its introduction into Canada in Colonial days. The Indians when they wore belts—and this seems to have been exceptional before 1800—were strongly under the influence of the French; but there is no evidence of finger weaving in France, or elsewhere in Europe, except only in Norway and possibly Lapland, where finger woven garters are made. It is possible that it was a traditional handicraft in other European countries and has been forgotten. The alternative would seem to be that it was, as demonstrated by Wissler and Amsden, a type of weaving widely diffused in prehistoric and historic America, which was adopted from the Indians and further elaborated by early French colonists.

Periodicity of Influenza

VARIOUS attempts have been made to determine the periodicity of influenza epidemics. If this could be done, it would be possible to foretell when an epidemic might be expected and to take some measure in advance for dealing with it. Brownlee in 1919–23 accounted perfectly for the outbreaks from 1890 to 1895 on the basis of a 33-week cycle, but this 'one phase' theory failed for the series of waves after 1895. Douglas Webster now claims that by adopting a 'two phase' theory, the epidemic waves of influenza may be accounted for (*Edinburgh Med. J.*, 46, No. 9, 591). The standard period is 33 weeks, with a $\pm$ 3 weeks' variation (phase 1), though missed periods often occur. Sixteen to seventeen weeks after the peak of a phase 1 major epidemic, a phase 2 minor epidemic is likely to occur and to be repeated every 33 weeks or thereabouts; that is, a major or minor epidemic tends to occur every 16 or 17 weeks with occasional misses. On this basis, all the epidemics from 1918 to February of this year appear to be accounted for, and a major epidemic is due in February, 1941, with a phase 2 epidemic of some severity in February, 1940.

The Panama Canal as a Fish Highway

HAS the opening of the Panama Canal enabled fishes from the Atlantic Ocean to enter the Pacific, or vice versa? There is the difficulty of negotiating the locks, and the greater difficulty for most of enduring a journey of forty miles through the fresh water between the locks at the opposite ends of the Canal. Samuel F. Hildebrand to some extent answers the question in his account of the fishes which have been found throughout the Canal and the invertebrates which inhabit the various locks (*Zoologica*, **24**, 15; 1939). He finds that while the locks do not form serious barriers, the difference in salinity does, and that as a consequence the fishes which occur beyond the sea-locks and are most likely to complete the journey from ocean to ocean belong to species which inhabit almost indiscriminately salt, brackish and fresh water. These include the gobies or guavinas, several species of Centromorphidæ and Gerridæ, a few species of burros (Pomadasys) and the tarpon. Indeed the tarpon has been known to have traversed the Canal from Atlantic to Pacific on at least four occasions. The locks shelter a varied invertebrate fauna, which includes sponges, Hydrozoa, Alcyonaria, Mollusca, crabs and shrimps, and these may help to sustain the migrating fishes during part of their journey.

Evolution of a Sun-fish

THE disk-like shape, excessive lateral flattening, and abbreviated body of a sun-fish are so unusual that special interest attaches to the elucidation of the stages by which such an oddity arose. Some years ago (1933), W. K. Gregory suggested a probable evolution based upon skull characters; now Henry C. Haven, convinced that other parts of the anatomy may be traced in evolution as well as the skull, has arranged what approximates to an evolutionary series illustrating the development of the locomotor apparatus (*Bull. Amer. Mus. Nat. Hist.*, **76**, 143; Sept. 1939). The series runs from a normal percomorph fish, the striped bass, to the acanthurid Hepatus, the trigger-fish Balistes, the porcupine-fish Diodon, and by way of a hypothetical intermediate stage to the nipple-tailed sun-fish, Masturus. A large plate illustrates very strikingly the modifications in musculature and fin-arrangement which lead to the sun-fish, perhaps the most remarkable change being the loss of a tail fin and the formation of a new or pseudo-caudal fin by extension of the dorsal and anal, which meet around the caudal end of the vertebral column. It is surprising to learn that the characters of the alimentary tract indicate that sun-fishes are bottom-feeders, that the skin, skeleton and the loss of the air-bladder suggest that they live in deep water, and that the form of the fins with their powerful muscles indicates an active existence.

Trichinosis in Pigs

AN extensive survey of pigs in eastern Canada has been carried out in 1937 and 1938 with the view of determining the incidence of *Trichinella spiralis*. All samples were selected at random and no selection was made, except that samples were examined only from hogs of which the district of origin was known (*Canadian J. Research*, **17**, Sect. D., 151, 1939).

T. W. M. Cameron finds that of 2,000 hogs examined, only 15, or 0·75 per cent, were infected. In the United States during the same years the Bureau of Animal Industry reports in 1937 an infection of 3·4 per cent where the hogs were fed on garbage and 0·32 per cent where they were not fed on garbage, the corresponding figures for 1938 being 10·0 per cent and 1·0 per cent. In Canada the feeding of hogs upon uncooked garbage is prohibited, and Cameron's figures agree closely with the corresponding statistics from the United States. There seems little doubt, therefore, that the majority of pigs infected with trichinosis in North America owe their infection to feeding upon raw garbage. Where garbage has been cooked before being served to the pigs, the incidence of the parasite falls to a level similar to that associated with clean food.

Multiple Allelomorphism in Cotton

R. A. Silow (*J. Genetics*, **38**, 229–276; 1939) has investigated further the multiple allelomorph series governing leaf-shape in cotton, which now includes two further members, one from *Gossypium anomalum* and a strain of *G. arboreum*. The author shows that the two pairing complements which influenced leaf-shape (lobe- width and length) are controlled independently by the genes. In regard to lacination, the order of genes is L^1-L^n and L^a-L-l, and in regard to lobe-width L^1-L^n and $L-L^a$ and l. It is suggested that the gene is compound with two gene centres controlling lacination and lobe width respectively. Both field and mutant allelomorphs exhibit a similar degree of partial dominance, a situation which is thought to be different from the previously accepted dominance relationships. Theories relating to the nature of gene action and dominance are discussed, and a theory is put forward that dominance is a function of the interaction of allelomorphs, dependent upon the possible expression of the particular character, and also upon other genes working to the same effect.

Origin of the Duke Cherries

It has been suggested that the Duke cherries ($2n=32$) are hybrids of the diploid sweet cherry ($2n=16$) and the sour cherry ($2n=32$). Again some have thought that the Duke cherries are tetraploid forms of the sweet cherry. K. Hruby (*J. Genetics*, **38**, 125–132; 1939) has investigated the problem by analysing the meiosis of the Duke cherries and of their triploid hybrids with the sweet cherry. In place of bivalents, as in the sour cherry, a high proportion of quadrivalents are found in the Duke cherries and 100 per cent trivalents are found in one third of the meiotic cells of the triploid hybrid. This provides strong evidence that the Duke cherries are auto-tetraploids of the sweet cherry.

Structures of Diacetone Dulcitols

Pizzarello and Freudenberg in 1930 proposed structures for the two diacetone dulcitols (originally described by Fischer in 1915) in which they were represented as enantiomorphous, the α-compound being 3, 4 : 5, 6-diacetone dulcitol and the β-compound 1, 2 : 3, 4-diacetone dulcitol. The absence of optical activity and the ready separation of the two compounds by fractional crystallization, as well as other properties, are strongly against the structures proposed by Pizzarello and Freudenberg, and R. M. Hann, W. D. Maclay and C. S. Hudson (*J. Amer. Chem. Soc.*, **61**, 2432; 1939) have now shown that the two compounds are structural isomers. The β-diacetone dulcitol is 2, 3, 4, 5-diacetone dulcitol, a *meso*-form. The α-diacetone dulcitol is 2, 3, 5, 6-diacetone-D, L-galactitol, a racemic form. A cyclic acetal shift was shown to be the cause of the unusual changes noticed by Fischer and Bergmann in the acylation of α-diacetone dulcitol, which corresponds with the passage of 2, 3, 5, 6-diacetone-D, L-galactitol to 1 : 6 dibenzoyl-2, 3, 4, 5-diacetone dulcitol.

Palladium-Deuterium Equilibrium

In continuation of the measurements of the isotherms for the absorption of hydrogen by palladium made by Gillespie and Galstaun (1936), the corresponding system with deuterium has been measured by L. J. Gillespie and W. R. Downs (*J. Amer. Chem. Soc.*, **61**, 2496; 1939). The results with hydrogen were confirmed, and a series of isotherms for deuterium and palladium black was obtained from 200° to 300°, including a critical point at 276°, 35 atm. pressure and 0·25 atom D per atom Pd. A reluctance in forming the second solid phase was overcome by pretreatment with hydrogen. For a given temperature and pressure the absorption of deuterium is less than that of hydrogen; horizontal lines appear in the deuterium isotherms at pressures 2·3–2·5 times the pressures of the corresponding hydrogen horizontals. The locus of compositions of coexistent solid solutions in the phase diagram is smooth and continuous without rising steeply at any simple atomic ratio; hence it is concluded that no palladium deuterides exist in the region above 200°. As the composition of the second solid phase is practically Pd_2D at 200° (like the hydrogen system), further work at lower temperatures might show the existence of this compound.

Structure of Glaciers

M. F. Perutz and G. Seligman (*Proc. Roy. Soc.*, A, **172**, 335; 1939) have investigated the transition of granular compacted snow (firn) into glacier ice, and the mechanism of glacier flow. The experiments were conducted on the Great Aletsch Glacier and formed part of the work of the Jungfraujoch Research Party of 1938. Samples of the glacier were taken and the size, shape and orientation of the crystals determined by the methods of optical crystallography. It was found that during the transition of firn into glacier ice the crystals grow largely by the refreezing of melt water retained in the capillaries. The firn crystals are largely oriented with their hexagonal axes normal to the glacier surface—this is ascribed to the influence of the temperature gradient present during refreezing or sublimation. In the course of 6–8 years, the crystals assume random orientation, and it appears that in the firn region there is no laminar flow, and that the motion of the glacier is due to haphazard motion of small crystalline units. This was shown by observing rows of indicating pins in pits and crevasses. In the ice region lower down the glacier both laminar and non-laminar flow occur. The crystals again become partly oriented with axes normal to the direction of flow, and the size of the crystals increases. The phenomenon is compared to the rolling of a metal sheet—it involves the growth of crystals in certain favoured orientations and their deformation by gliding.

WORK OF THE ARCHÆOLOGICAL SURVEY OF INDIA*

SIR LEONARD WOOLLEY'S report on the archæological survey of India is a comprehensive document covering in some detail the large number of problems which presented themselves to its author during his three months' stay in the country, and is characterized by a frankness of statement and freedom of criticism unusual in an official publication. It is, however, clear that with issues vital for the future of archæological studies and of interest not to India alone but also to the whole body of scholarship concerned with the scientific investigation of past civilizations, the situation necessitated plain speaking. As Sir Leonard points out, moneys from a reduced allocation from public funds were being wasted by misdirection, evidence was being destroyed through ignorance, incompetence or lack of training, and at the same time not only was no attempt being made to remedy lack of knowledge of India's cultural history or fill in the gaps in the archæological record, but also the very existence of these defects was barely realized.

The original terms of reference upon which Sir Leonard was invited to report by the India Office in March 1938 covered the most promising sites or areas for excavation; the best methods for the speedy and fruitful development of exploration activities in general, regard being had not only to Government but also to non-official agencies, such as universities, learned societies, etc.; the best method of training or selecting officers for exploration work; and finally, any general points bearing on the field of exploration and excavation not covered in the preceding.

This formulation of the problem of archæological exploration in India obviously leaves something to be desired; and Sir Leonard was unlikely to overlook its defects as the charter of any commission he could undertake. He had in mind, of course, the report of the Museums Association on the museums of India. He pointed out to the India Office that matters coming under the head of "general points" might well be of crucial importance, such as the character of the museums available for the custody of antiquities, finance, the capacities of the staff, and the like. He was assured that the more complete the report, the more it would be welcomed.

Sir Leonard began his study of the situation with some knowledge of the conditions which placed difficulties in the way of "fruitful development of exploration activities". On further examination, however, he found that his impression, gathered from the printed reports, that the unfavourable comparison of the work of the Department with that prior to the departure of Sir John Marshall in 1931 was due to financial stringency was entirely erroneous. After his inspection, he was forced to the conclusion "that the lack of money is not the principal reason for the setback in the progress of archæology in India . . . an increase in the grant unaccompanied by other changes would actually do more harm than good, for the truth is the Department is altogether lacking in men trained for the work they have to do. Everywhere plenty of enthusiasm, intelligence and learning were encountered; but experience and training were lacking and for this the members of the staff were not to blame."

In regard to the staff, it is further pointed out that owing to the lack of differentiation and specialization, each member is expected to be a superman: he is expected to be proficient in the work of conservation and excavation, may at any time be put in charge of a museum, and is in addition saddled with a mass of clerical work for which he has no special qualifications. Not only is differentiation in function essential, but also the training and tuition required cannot be obtained within the department as at present constituted. For this and other reasons Sir Leonard recommends the appointment of a temporary adviser on archæology, who could deal with all the points at issue.

Sir Leonard then proceeds to expand this general criticism and to put forward his recommendations in several chapters of his report, each dealing with some specific aspect of the situation—sites for excavations, excavation by non-Government bodies, the selection and training of officers, the work of an archæological department, excavation museums, general, and finance and personnel.

Apart from criticism of the work of the Department, the brief survey here given of the present state of archæological knowledge of India's past is illuminating. By 1931 the work at Taxila on the Bhir mound had thrown a little light on the few centuries preceding the Christian era, and Sirkap had done much for the Scytho-Parthian period. The religious monuments of the Buddhist age between the second and fifth centuries A.D. had been well exemplified in the north-west, and stray monuments of the Mauryan and Gupta period had been brought to light. Mohenjo-daro and Harappa had illustrated richly one phase of a culture about which no one could agree whether it was or was not Indian; and between it and Asoka, the next of which anything at all was known, there was a gap of two thousand years of blank ignorance. Of the cultural history of India not even the skeleton existed, and even for those periods which may be called historical the sequence of cultural history was quite unknown. From coins and scattered inscriptions there had been constructed a regnal sequence to serve as a framework of history, but that was all, and in any excavation it was impossible, unless coins or dated inscriptions were forthcoming, to fit to that framework such discoveries as might be made.

As further evidence of the little prospect of advancement of knowledge, reference is made to the absence of the surest basis for the establishment of a chronological scheme of cultural history—the study of pottery. Except for the pottery of the Indus culture, no information is available, and a pottery type cannot be dated within a thousand years. In South India the position is even worse. Of the two, or possibly three, phases of 'prehistoric' culture, not even the sequence or time relation has been ascertained, and

* A Report on the Work of the Archæological Survey of India. By Sir Leonard Woolley. Pp. ii+47. (Simla: Department of Education, Health and Lands, n.d.)

if the positive date of objects of clay, iron and bronze be demanded, the answer must allow of a margin of error of anything up to three thousand years. Of the minor arts of the historic period nothing is known at all; between 'prehistoric' and historic there is no correlation, and so far as cultural history is concerned, 'prehistory' may be said to continue to the sixteenth century A.D.

After such a scathing indictment of wasted opportunity, almost any recommendation would probably be acceptable; but Sir Leonard, while indicating where and on what considerations operations in the field might be extended, wisely counsels that in present conditions increased expenditure on excavation would be harmful rather than a benefit, until the work of the Department has been placed on a sound basis.

Except in so far as they are directed to ensure the increase of archæological knowledge in accordance with scientific method, Sir Leonard Woolley's recommendations in detail are the concern of the administrative authorities of the Government of India, rather than of interest to archæologists at large. In view of Sir Leonard's long experience and his wide and profound knowledge of the problems of archæological exploration, it may be accepted that his recommendations are such as to secure that the archæological staff shall be fully efficient to carry on excavations on sites chosen for their anticipated possibilities of advancing knowledge, in co-operation with a museum service also working to that end, the service being equipped and organized in such a manner as to afford facilities for the training of future officers; while the curtailment of unnecessary and wasteful activities, especially in misdirected conservation, will avoid excessive increase in the Department's budget. One recommendation to which heartfelt welcome will be given outside India is that for the appointment of two specially qualified officers to deal with the earlier prehistoric period, namely, the stone ages.

Of wider general interest are the sections of the report which deal with excavation by bodies other than the Survey and by organizations from outside. Much disappointment has been expressed in one quarter and another that enlargement of the provisions of the Antiquities Law has failed to attract non-official excavation. Sir Leonard rightly points out that the responsibility is to be laid on a law which, liberal as it is in form, allows no prescriptive right to the excavator of a share in the finds, but leaves this open as a matter of interpretation. This and other matters, including training in excavation for officials by reservation of the right of the Department to attach one of its officers to an expedition's personnel, are covered by amendments to the law here suggested. Provision for early publication is also made; while the importance of early publication in accessible and suitable form at a reasonable price by the Survey itself is strongly urged.

THE INFORMATIVE CONTENT OF EDUCATION

THE second report of the Committee of the British Association appointed to consider the gaps in the content of education to which Mr. H. G. Wells directed attention in his presidential address to Section L (Education) at Nottingham was presented at the Dundee meeting. The first report revealed a general agreement that Mr. Wells's suggestions were too wide in scope and too advanced for the capacity of the pupils concerned. There were, however, differences of opinion, and the present report shows in answer to inquiries by the committee the results attained by school-teachers in the studies commended by Mr. Wells. He, of course, when addressing the Association, used grown-up language suitable for his audience but not for children of the age of 7–11 years. It is clear now that much of the information he wished to see taught can be learnt and might be acquired with advantage by young children.

The results here noted and tabulated by school-teachers are very promising, in view of the small portion of time available for such teaching, and it is really important. We are not getting at present anything like the return we are entitled to expect from the vast sums spent yearly on education, and this criticism applies particularly to science and such allied subjects as geography, which reaches out on one side to history and on the other to scientific research. Though experts may differ as to the way in which geography should be taught, every one will agree that small children should learn to understand and use maps, so that they can find their own way about with confidence and help others, when questioned, by intelligent replies.

Nature study, so far, has had but poor results, though a host of useful books are available. One thing is evident: young children must, whenever it is possible, have the actual objects used before them. The plot of ground designed by one school for study is an excellent idea. Here "the course is recreative rather than formal, but at the same time special studies are made where accuracy is insisted on". The comment shows the survival of the view that education must be carefully dissociated from amusement. Biology for the young is not easy, and is perhaps best taken in connexion with personal hygiene. Many friends of education have long been convinced that too much is attempted in the curriculum of to-day. Thus the "Civics Course" of one school reminds us that in Russia this subject with a pronounced tinge of 'red' was forced on schoolmasters, who repudiated it and went back to teaching on the old lines. Here at least, in Mr. Wells's requirements, we are concerned with practical knowledge promoting good health and the pleasure and utility of good observation for all children. The juvenile standard of intelligence in this way in children in Great Britain is not equal to that shown by foreign children. Knowledge of other lands and ways of life is rightly emphasized. The sort of patriotism which declares that your own country is the only one which is right is out of date.

The juvenile sections of free libraries should be a great help and more useful, as implying effort, than B.B.C. talks. In general, the schemes of work printed are excellent, but a pertinent question asked is: How can the teacher find time or opportunity to keep up with all this, especially when he is confronted with the very wide method of stimulus known as

'encyclopædia work' practised in a London junior school? The observations on the junior schools note many omissions in science. Even if we agree that some of Mr. Wells's ideas are beyond young folks, some of the simpler work is disappointing; in elementary physiology, for example, questions about seeds and animals. The senior schools do not supply many records, but those given are elaborate enough to suggest the need for real refresher courses for teachers. Interest in science of some sort may be regarded as universal. Unfortunately it is not, and where teachers lack interest they are not likely to provide the stimulus which leads to permanent keenness in their pupils.

EDUCATION AND INDUSTRY

THE discussion on education as a preparation for industry which followed Dr. A. P. M. Fleming's presidential address on education for industry to Section L (Educational Science) of the British Association, delivered on August 31, was opened by a paper, read in his absence, by Mr. W. O. Lester Smith, director of education of Manchester, who stressed the importance of a sound general education and the significance of Hadow reorganization. Our educational neglect of the adolescent has led to wastage of human material. The wanton blow struck at the day continuation school clauses of the Fisher Act by the 'Geddes Axe' was probably the unkindest cut our educational system has ever suffered; it has prevented local authorities from making a satisfactory job of the youth problem.

Discussing the organization of technical education, Mr. Lester Smith referred to the value of regional co-operation and the necessity for a constant revision of the subject-matter of technical education to meet the needs of a competitive and scientific age. Although the Trades Union Congress adopted a cautious attitude to some modest suggestions in the Spens report for the infusion of technical teaching into the later stages of the secondary school curriculum, there are signs of a change in outlook. Employers are more disposed to see value in general education, and teachers are appreciating more fully the additional interest which an occupational bias can give to the last stage of school life. There is no strong evidence, however, in the post-graduate work in universities of a desire to assist industry to grapple with new problems. Industry as a career is regarded as a side-line, and industry and commerce will continue to rely mainly for its personnel, both leaders and rank and file, upon the less academic institutions and schools administered by local authorities. Finally, Mr. Lester Smith referred to the importance of facilities for training technical teachers and providing for the adequate dissemination of knowledge of new processes or of the achievements of research.

Sir Richard Gregory described opportunities open to apprentices at Portsmouth dockyard, while Dr. K. Fisher, headmaster of Oundle School, referring to the criticism of public schools that they give their pupils no chance of contact with the rest of the youth of the country, suggested that compulsory national service may remove that disability. Public schoolboys and other youths may thus become conscious of a common bond. Moreover, employers are increasingly anxious to find public schoolboys to enter their service.

The allied discussion on education in industry, which followed on September 1, was opened by Mr. J. D. Langmuir, who emphasized the responsibility and obligation of all who employ young workers to see that they have adequate practical and technical training to suit their abilities. The narrow specific workshop or office training should be provided by the employer, but the responsibility for technical training should be shared with those responsible for education. There is little or no organized and systematic workshop training in Scotland, and the position of technical education is equally unsatisfactory. There has been no co-operation between education and industry, and real progress in technical education is impossible in its absence and until employers take more interest in both day-school and technical education.

After criticizing both Scottish day-school and technical education, Mr. Langmuir advocated a bolder policy of grading, which would give the pupil free choice of a course suitable for his occupational desires. A boy with an occupational objective is more likely to remain to obtain the certificate which would facilitate entrance to his chosen career. Education should be less bookish; attempts to convert secondary schools into miniature universities resisted. Supporting the idea of the junior technical school, he pleaded for closer co-operation with industry on the lines of the Edinburgh continuation class scheme. He stressed the obligations of employers for technical education of young workers and the limitations of works schools, and he also discussed the possibilities of introducing day continuation classes. Before this is possible, he said, leaders of industry and commerce must recognize the importance of such education. In technical education we are far behind Belgium, Denmark and Germany, and the provision of a well-thought-out scheme of technical education for the rank and file of our workshops and commercial houses is long overdue.

A written communication by Mr. G. L. Darbyshire, of the London Midland and Scottish Railway, which was read by Dr. Fleming, described the methods of recruitment and qualifications required for engagement by that company, as well as the training arrangements, both internal and external. In addition to classes for instruction in such special branches as block signalling, locomotive working, permanent way maintenance, etc., and lectures on special problems arranged internally, the staff are encouraged to proceed in further education. Films as well as departmental publications are used freely for instructional purposes.

Discussing part-time education outside the works, Principal J. Cameron Smail, of the Heriot Watt College, Edinburgh, referred to the strain on individuals involved by part-time education in evening classes, although the results have justified the method. The outstanding results achieved with day classes in the dockyard scheme, however, have shown the

possibilities of a daytime system for educated students; the psychological value of the sandwich system is also insufficiently appreciated and merits further investigation. Principal Smail referred to the danger of taking too narrow a view of technical training, to difficulties of staffing and equipment and to the importance of full contact between teachers in technical schools and current workshop and factory practice.

Dr. F. J. Chapman, of the Board of Education, stated that the most urgent educational problem before industry in Great Britain at present is the training of craftsmen. For craftsmen, as well as for technologists and managers, training involves the learning of techniques, the acquisition of skill and the study of technology. The main problem in the first is the apportionment of the training required between systematic instruction in schools on one hand and practical experience on the other; and in regard to the second, the best methods of co-operation between industry and educational institutions.

Mr. S. E. Goodall described the form of apprenticeship developed by the Metropolitan-Vickers Electrical Co. Ltd., while the concluding paper, by Prof. Willis Jackson, dealt with post-advanced education. During the past few years, provision for post-graduate practical training has been considerably extended, and on the electrical side of engineering practically every firm of note has now introduced a scheme of post-graduate apprenticeship. In exceptional circumstances only are graduates recruited direct to technical or other positions. It is now widely recognized by industrial concerns that the primary function of university courses in applied science is not to provide them with ready-made specialists, but rather to develop the ability to think deeply and critically in terms of those fundamental principles which underlie all the specialized branches of a particular applied science.

One of the advantages of the post-graduate apprenticeship system lies in the opportunity it affords for the acquisition of general engineering knowledge as well as specialized information. The ability to acquire information by such independent effort is one of the greatest assets which a man can possess, and one which our educational institutions should seek to develop. In this connexion, the recent development in local areas of post-graduate courses of instruction—termed post-advanced courses, since they also serve the needs of men who have proceeded through part-time evening courses to Higher National Certificates—of a specialized technological character appropriate to the industrial needs of those areas, is of special value. Prof. Jackson outlined certain of these courses and stressed the educational significance of the success and extension of such schemes.

WORK OF THE FORESTRY COMMISSION

IN the nineteenth annual report of the Forestry Commission for the year ending September 30, 1938 (London: H.M. Stationery Office, 1939), there are some interesting particulars on private forestry. Seven eighths of the woodlands in Great Britain, it is stated, are privately owned.

Early in 1938 the Commissioners commenced a census of all private woods, a field staff of sixteen being employed on the work. This undertaking was being carried out by trained men, data regarding area, type, age, condition, species, volume by species and girth classes of each unit of woodland being recorded. So far, 613,000 acres had been dealt with. Although the visits of Government officials on private estates are never greeted with unmixed approval, yet it may be said for this piece of bureaucratic work that the results aimed at justify the means adopted. Both in the national interests and in those of the private owner the information obtained will be invaluable. Many private owners of woodlands were aware that their property of this type was by no means yielding an adequate return; whilst a considerable percentage, through neglect and ignorant management, brought in no return whatsoever. The remission of taxation of young, properly grown woodlands which cannot in the nature of things bring in any return to the planter until they have reached a marketable value—usually a certain dimension—is understandable and mere justice. But there appears little justification to grant remission of this type on areas of poor and neglected woodland the marketable value of which is nil. From statements in this report and articles in the Press, it is evident that landowners have become alive to this problem and are endeavouring to come to an understanding upon a broad forest policy to be followed. That this is a necessary preliminary step is demonstrable. For when all is said and done, as the Continent of Europe well shows, the policy of a State forest department is not in all particulars adapted to the private owner; and is often quite impracticable for such.

The report has some interesting remarks to make upon amenity, the New Forest, and national parks, all of which have already been noted in NATURE.

The total addition to the woods of Great Britain through the operations of the Commission during the year under review was 20,300 acres, approximately 54 million trees being planted; of these, 47 per cent were Norway and Sitka spruce, 24 per cent Scots and Corsican pine, 9 per cent European and Japanese larch, 1 per cent Douglas fir and 16 per cent broad-leaved species.

The public, through the Commissioners, owned 125 forests in England and Wales and 107 forests in Scotland. The total area afforested during the nineteen years of the Commission amounts to 365,000 acres. Some of the earlier planted areas are now having the first thinnings made in them. The total area now controlled by the Forestry Commission in Great Britain amounts to 1,100,000 acres.

The year under record had some dangerously dry periods in it, commencing as early as late February in parts of Great Britain. Consequently the fire danger and damage were serious, being the worst year on record for the Commission except for 1929. The Commission attributes the damage done to railways and the general public.

SCIENCE NEWS A CENTURY AGO

G. T. Vigne's Travels in Central Asia

AT a meeting of the Asiatic Society on November 2, 1839, the director, Prof. Horace Hayman Wilson (1786–1860), introduced the traveller Godfrey Thomas Vigne (1801–63), who had recently returned home from India after a journey of seven years during which he had passed through Kashmir, Great and Little Tibet, the Punjab, Kabul and other regions, some of which had never been visited by any European, or at least had never been fully described.

After referring to the travels of the Jesuits, of Foster, Moorcroft, and Jacquemont, Prof. Wilson said, "the country north-east of Cashmere is quite new ground, and the visit of Mr. Vigne to Iskardo cannot fail to be of very great interest. His observations in that quarter will add very materially to our knowledge of the geography of that lofty region, and to that of the course of the Indus, from the frontiers of Ladakh to its issue upon the plains of India. It was to be regretted that Mr. Vigne had not been able to visit the district of Nobra and to trace the course of the Shayuk, from its confluence with the Indus to its source, but he had visited a good deal of the lower part of this northern branch, and had accurately traced the main body of the river on the west of Iskardo, to where it turns to the south, and breaks through the mountain barrier which opposes on that side. The hill States of Chambra, and others on this quarter, had also been visited for the first time; and the knowledge thus obtained had enabled us to complete the geography of the upper part of the Punjab".

Three weeks later, on November 25, Vigne gave an account of his journeyings to the Geographical Society.

Duty of Steam Engines in Cornwall

IN its issue of November 2, 1839, the *Athenæum* reviewed the "Historical Statement of Duty performed by the Steam Engines of Cornwall" compiled at the request of the British Association by Thomas Lean and Brother.

In its remarks on the statement, the *Athenæum*, after referring to the work in Cornwall of Savary, Newcomen, Smeaton and Watt, and of the improvements made, said: "Yet it is wonderful how slight is the effect which the experiments of this remote county have produced on the practice of the other parts of the mechanical world, and especially of Great Britain. While the world teems with idle projects of ridiculous 'improvements' . . . and while every one of these finds its devotee and dupe, it is truly wonderful, and most melancholy, that the simple, but very important practical truths, provisions and maxims, so well known, and so ably practised, by the Cornish steam-engineers, have made their way so slow among their fellow countrymen—truths, whereby power is obtained and economized, and fuel saved, to a greater extent, in every day's practical experience, than had been imagined possible, even by the most wild and ignorant schemer. Yet these great results have been obtained by the Cornish engineers, not from any complex or intricate mechanism—not from any patent or secret process—not from any great discovery or invention—but from the quiet and unpretending application of the best known and most common-place truths to the common steam-engine."

UNIVERSITY EVENTS

CAMBRIDGE.—E. S. Shire, of King's College, has been appointed University lecturer in physics.

B. G. Wilkinson, of Downing College, has been appointed to the Frank Smart Studentship of botany.

LEEDS.—The West Yorkshire Coal Owners' Association is renewing its donation of £1,000 a year to the Mining Department of the University for a further period of seven years.

LONDON.—The title of reader in chemistry in the University has been conferred on Dr. Fred Barrow, in respect of the post held by him at Birkbeck College.

SHEFFIELD.—Dr. A. H. Lamberton has been appointed assistant lecturer in chemistry.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT MASTER (GRADUATE IN ENGINEERING) in the Consett Secondary School and Technical Institute—The Director of Education, Shire Hall, Durham (November 3).

PSYCHOLOGIST (EDUCATIONAL AND MEDICAL) in the Child Guidance Centre and for the Mental Hospital of Sunderland County Borough—The Medical Superintendent, Cherry Knowle Hospital, Ryhope, near Sunderland (November 9).

ENGINEER SUB-LIEUTENANTS (two) in the Royal Indian Navy—The Secretary, Military Department, India Office, Whitehall, S.W.1 (quoting R.I.N. Recruitment) (November 14).

TEMPORARY FORECASTERS, GRADE II (MALE) in the Meteorological Office—The Under-Secretary of State, S.2.B.(Met.), Department Q.A., Air Ministry, Adastral House, Kingsway, W.C.2.

TEMPORARY METEOROLOGICAL ASSISTANTS (MALE) in the Meteorological Office—The Under-Secretary of State, S.2.B.(Met.), Department Q.J., Air Ministry, Adastral House, Kingsway, W.C.2.

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Department of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry. Leaflet No. 10: Chlorine. Pp. v+7. (London: H.M. Stationery Office.) 3d. net. [910

Historic St. Andrews and its University. By Prof. John Read. Pp. 30+7 plates. (St. Andrews: W. C. Henderson and Son, Ltd.) [910

Hannah Dairy Research Institute. Annual Report for the Year ending 31st March 1939. Pp. 29. (Kirkhill: Hannah Dairy Research Institute.) [1110

Other Countries

The Rockefeller Foundation: International Health Division. Annual Report, 1938. Pp. ix+233. (New York: The Rockefeller Foundation.) [410

South Australia: Department of Mines. Mining Review for the Half-Year ended 31st December 1938. (No. 69.) Pp. 107+4 plates. (Adelaide: Government Printer.) [910

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Mines. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories), January to June 1938. (No. 792.) Pp. ii+148. (Ottawa: King's Printer.) 50 cents. [1010

Department of Agriculture, Fiji. Annual Bulletin of Divisional Reports, 1938. Pp. iv+106. (Suva: Government Printer.) 2s. 6d. [1010

The Future of Medicine. By Baidya Nath Charan Roy. Pp. iv+18. (Calcutta: The Author, 7 Loudon Road.) [1110

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Volumes marked with an asterisk (*) have been received at "NATURE" Office

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Chapman, Sydney, and **Cowling, T. G.** The Mathematical Theory of Non-Uniform Gases : an Account of the Kinetic Theory of Viscosity, Thermal Conduction, and Diffusion in Gases. Sup. Roy. 8vo. Pp. xxiii +404. (Cambridge : At the University Press, 1939.) 30*s.* net.*

Collins, A. Frederick. Simplified Household Mechanics. Ex. Cr. 8vo. Pp. xx +317. (New York and London : D. Appleton-Century Co., Inc., 1939.) 7*s.* 6*d.* net.

Gilmour, D. M., and **Clark, A. C.** Everyday Mechanics. Cr. 8vo. Pp. 110. (Glasgow : Robert Gibson and Sons, Ltd., 1939.) 2*s.* 6*d.*

Gunlake, J. H., and **Wood, C. F.** Premiums for Life Assurances and Annuities, by J. H. Gunlake ; The Treatment of Extra Risks, by C. F. Wood. (Institute of Actuaries Students' Society's Consolidation of Reading Series.) Demy 8vo. Pp. 126 +72. (Cambridge : At the University Press, 1939.) 9*s.* 6*d.* net.*

Gurr, Bertram T. The Arithmetic of the Workshop. (Macmillan's Senior School Series : Terminal Book G.) Imp. 16mo. Pp. vi +142. (London : Macmillan and Co., Ltd., 1939.) 1*s.* 6*d.*

Karelitz, G. B., Ormondroyd, J., and **Garrelts, J. M.** Problems in Mechanics : Based on the Original Collection of I. V. Mestchersky. (Engineering Science Series.) Med. 8vo. Pp. ix +271. (New York : The Macmillan Company, 1939.) 11*s.* net.*

Miller, Dayton Clarence. Sparks, Lightning, Cosmic Rays : an Anecdotal History of Electricity. (Christmas Week Lectures for Young People, 1937, The Franklin Institute.) Demy 8vo. Pp. xvii +192. (New York : The Macmillan Company, 1939.) 11*s.* net.*

Rogers, J. S. Physics for Medical Students : a Supplementary Text Book. Second edition, revised and enlarged. Demy 8vo. Pp. xiii +304. (Melbourne : Melbourne University Press ; London : Oxford University Press, 1939.) 12*s.* 6*d.* net.*

Shearcroft, W. F. F., and **Avery, J. H.** Practical Physics. Demy 8vo. Pp. xvi +268. (London : William Heinemann, Ltd., 1939.) 8*s.* 6*d.**

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Engineering

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Clyne, R. W., Edited by. Engineering Opportunities. Demy 8vo. Pp. xxv +397. (New York and London : D. Appleton-Century Co., Inc., 1939.) 12*s.* 6*d.* net.

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Windel, W. Deutsche Elektrizitätswirtschaft. Sup. Roy. 8vo. Pp. 411 +134 plates. (Berlin : Verlag für Sozialpolitik, Wirtschaft und Statistik, 1939.) 32 gold marks.

Chemistry : Chemical Industry

Anderson, Arthur K. Essentials of Physiological Chemistry. Second edition. Med. 8vo. Pp. ix +323. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1939.) 13*s.* 6*d.* net.*

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Fren, George W. Condensed Review of Pharmacy. Fourth edition. 8vo. Pp. 109. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1939.) 10*s.* net.

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